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AEROSPACE REVIEW AND FORECAST 1980/81

THE AEROSPACE POST

BY KARL G. HARR, JR.
President, Aerospace Industries Association

In this moment of national political transition, it seems appropriate to address three areas which impact heavily on the aerospace industry, hence on the nation's economic, defense and technological postures.

First, space. The nation's space effort, let's face it, has been merely limping along for the past several years. It has been in a prolonged slump and promises to stay there unless and until it finds a new and broadly based constituency. We must begin by recognizing that it will never recover the same enormous, but transitory, constituency that grew out of American public shock at the demonstration of Soviet technological prowess represented by Sputnik and the early cosmonaut flights.

That constituency was essentially nationwide. It was based on a severely wounded national pride, but when that pride was restored by the successful Apollo program the public support base evaporated as quickly as it had developed. It never will return in anything like its original form.

Space has a dedicated scientific constituency, but one which is simply too narrow to engender the necessary political support. We all "ooh" and "ah" at the marvels of planetary exploration, but against competing national priorities, getting support for adequate funding is like pulling teeth.

However, there exists a potential constituency for our national space effort which has the breadth and depth to provide support over an indefinite period. We are, almost imperceptibly and perhaps even unconsciously, already on our way to tapping it. It is composed of all those many elements of our society—and the number is growing daily—who see in the domain of space a better means of accomplishing a broad variety of beneficial objectives. All that is necessary to draw on such vast resources is to demonstrate the feasibility—technical and economic—of the practical utilization of space.

We will soon be better able to make such demonstrations. The Space Shuttle represents a giant step forward in this regard. Foreign governments and domestic companies are already bidding furiously against each other for space aboard the Shuttle. What happened in satellite communications—now a booming industry with so many commercial systems in operation we have just about saturated the geosynchronous orbit—may happen in new fields of space exploitation, such as advanced communications and environmental systems, global resources monitoring, manufacturing in space, or commercial operation of space transportation vehicles.

Thus, if the new Administration wants to tap the wellspring that will insure continuing support for a healthy national space program, it should set as a major goal the elimination of technological and economic obstacles to the utilization of space by the broadest possible segment of society. In short, it should do everything possible to make space commonplace.

Secondly, a word about commercial aviation. We are still doing well in the world marketplace, but there are disturbing signs on the horizon. This is an area where we should be more concerned about the future than dissatisfied with the present.

The trend evidenced by sales of foreign-built aircraft is one such concern. In the overall competition for free world commercial jetliner sales, foreign manufacturers held only five percent of the market at the beginning of the 1970s. By the end of the decade, their share was 24 percent.

Our foreign competitors enjoy the full support of their governments, expressed in a broad variety of tax and other incentives. The U.S. government, by contrast, seems determined to maintain roadblocks to our effective performance in foreign trade. Our export policy is a patchwork affair in which political and moral considerations are too often the basis for denying export licenses. Our competitors are free to form consortiums for co-production and marketing of commercial transports; U.S. manufacturers face severe limitations in that regard. Supported by their governments, our competitors can offer very attractive financing terms; the funding constraints imposed on the U.S. Export-Import Bank are denying U.S. manufacturers competitive equality.

We are operating at serious competitive disadvantage because our government does not fully recognize the critical importance of foreign trade to the nation's economic health. The new Administration can lead the way to an improved foreign trade posture by establishing a policy that accords high priority to export sales; by backing such a policy with an operational framework dedicated to promoting, rather than retarding, export growth; and by urging the Congress to provide American exporters incentives similar to those available to the competition. In short, given the vital contribution of commercial aircraft sales to our overall national economy, we respectfully suggest that the Administration's goal should be to maintain U.S. leadership in one of the few key areas where leadership still exists.

As for defense, frankly, we are not doing well and if this nation wants an adequate defense industrial base over the next decade and beyond, some things will have to be turned around—and soon.

For one thing, we will have to stop kidding ourselves about inflation. If the true rate is 12 or 13 percent, we must stop projecting the costs of weapons programs on an assumption of eight percent. All that brings about is the cutting back of quantities of weapons originally planned and the higher costs per unit we have so often seen. In how many programs have we seen, in the end, the delivery of less than half the number of weapons at a cost greater than the original estimate for the total buy?

We also have to reverse the dilution of program responsibility inherent in the increased layering of controls pres-

URE: 1981

ently occuring. The proliferation of naysayers and meddlers including—increasingly—Congressional staffers, has so muddied the waters as to who is responsible for what, that accountability is indeed hard to find. Everyone can say "no," "delay," "change" or "study," but no one can say "yes" and make it stick. As a former Chief of Staff said, "When something goes wrong, you can't even figure out who to fire anymore." We must put the responsibility and authority back in the military services where it belongs.

We must move to multi-year procurement funding. The cost of our present one-year method is simply too great. Industry, at all levels, is loath to make capital investments for programs funded for one year only, and both business and government planning is largely defeated by this practice. Multi-year funding offers dramatic benefits in defense programming stability. It would enable industry contractors to plan production and tooling more efficiently. They could achieve significant economies by buying materials and components in larger quantities. That would bring down the unit cost of a weapon system or equipment item.

How much? General Alton D. Slay, commander of the Air Force Systems Command, provided an estimate in Congressional testimony. He said that multi-year procurement would allow DoD to "routinely save from 10 to 30 percent of the contract price" on selected acquisitions. Savings of such order could go a long way toward offsetting the inevitably rising cost of high technology defense systems.

Finally, a thought about our overall defense philosophy. History tells us that a Maginot Line or Knights of the Round Table philosophy is the road to extinction, that relying too heavily on having too little of the best is not the path of wisdom. Perfect can be the enemy of good in a military context.

The theory of qualitative superiority is valid—up to a point. The question is have we reached that point? We and our allies are now so heavily outnumbered in most categories of weapon systems it is time to take a good hard look at our assumption that qualitative superiority is adequate to compensate for our quantitative inferiority.

In summary, Aerospace Industries Association suggests to the new Administration these major goals.

In space, concentrate on making the utilization of that domain so feasible as to make it a commonplace option for businesses and governments to take full advantage of the economic and social gains that space offers.

In commercial aircraft, concentrate on maintaining U.S. leadership in the world marketplace.

In defense—most important of all—concentrate on getting new systems into the inventory, even at the risk of passing up the last increment of technological advance, in the name of sufficient quantity and timely delivery.

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The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems.

Foster understanding of the aerospace industry's responsibilities in the space exploration program.

Foster understanding of civil aviation as a prime factor in domestic and international travel and trade.

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

AEROSPACE is published by the Aerospace Industries Association of America, Inc., the national trade association of the designers, developers and manufacturers of aircraft, missiles, spacecraft, their propulsion, navigation and guidance systems and other aeronautical systems and their components.

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Aerospace Review and Forecast 1980/81

The aerospace industry closed out the first year of the new decade on a high note, recording new statistical peaks in sales, backlog and contribution to the U.S. balance of trade. Here are the highlights of 1980, based on preliminary estimates which will undergo refinement in coming months:

Sales. Total industry sales amounted to $50.5 billion, up from $45 billion in 1979. In percentage terms, the increase over the previous year was slightly above the rate of inflation, so 1980 was a growth year—but the growth was of less dramatic order than that of 1978/79.

The largest increment of gain was in sales to the Department of Defense, a change from 1979 when commercial sales accounted for the major increases. This was due to cutbacks in commercial transport programs, occasioned by soaring operating costs and sharply reduced earnings of the airline industry. Nonetheless, commercial sales increased substantially and there were moderate gains in the civil space and non-aerospace categories.

In the interests of perspective, it is the industry's practice to compare each year's sales volume with that of the all-time peak year—1968—by converting sales figures to constant dollars. On that basis, 1980 sales constitute roughly four-fifths of the 1968 volume. In constant dollar terms, 1980 sales were almost $6 billion below those of the peak year. However, 1980 constant dollar sales represented the highest volume since 1969.

Backlog. Orders on the industry's books at the end of 1980 were valued at more than $97 billion, up from $75 billion at year-end 1979. The 30 percent increase just about matched the strong 1979 rate of increase.

Exports and trade balance. Exports increased substantially, from $11.7 billion in 1979 to $14.6 billion in 1980. The increase of 24 percent compares with a 17 percent gain experienced in 1979. Despite an increase in imports, the aerospace trade balance mounted from $10.1 billion in 1979 to $11.3 billion in 1980. The aerospace industry continued as the nation's leading manufacturing exporter.

Earnings. Profit after taxes, measured as a percentage of sales, declined from 1979's five percent to 4.4 percent in 1980. The aerospace profit rate remained well below the average for all U.S. manufacturing corporations, which also declined—from 5.7 to five percent.

New Plant and Equipment Outlays. Gearing up for the competitive environment of the 1980s and for the production of new commercial transports, the industry significantly increased its capital investment. Expenditures of more than $2.6 billion in 1980 represent a 15 percent increase over the previous year even after adjusting for inflation.

Employment. Aerospace industry employment topped 1.2 million at year-end 1980, the highest figure since 1969. However, the increase over 1979 was relatively small—four percent. The industry's payroll reached an all-time high $28.2 billion, up 18 percent over the previous year.

In summary, the aerospace industry's activity curve, as measured by sales performance, flattened slightly during 1980 but continued the upward climb initiated in 1978.

FORECAST

Perhaps the most significant projection for 1981 is that sales to the Department of Defense are expected to move further ahead of commercial sales. This represents negation of an earlier forecast: that commercial sales would outstrip DoD sales in 1980/81. The reasons that is not happening are twofold: the uncertain financial health of the airline industry caused deferments of new transport deliveries, and military sales are increasing at a greater rate than was earlier anticipated. Aerospace Industries Association estimates 1981 defense sales at $22.9 billion, commercial sales at $21.3 billion. Both figures represent substantial increases over 1980.

Overall 1981 industry sales are estimated at $57 billion, a figure compounded of $48.7 billion in sales of aerospace products and services plus non-aerospace sales of $8.3 billion. The sales growth factor—1981 over 1980—constitutes a boost on the order of 13 percent. This increase, however, will not significantly change the size of the industry's labor force; estimates indicate employment growth of less than one percent in 1981.

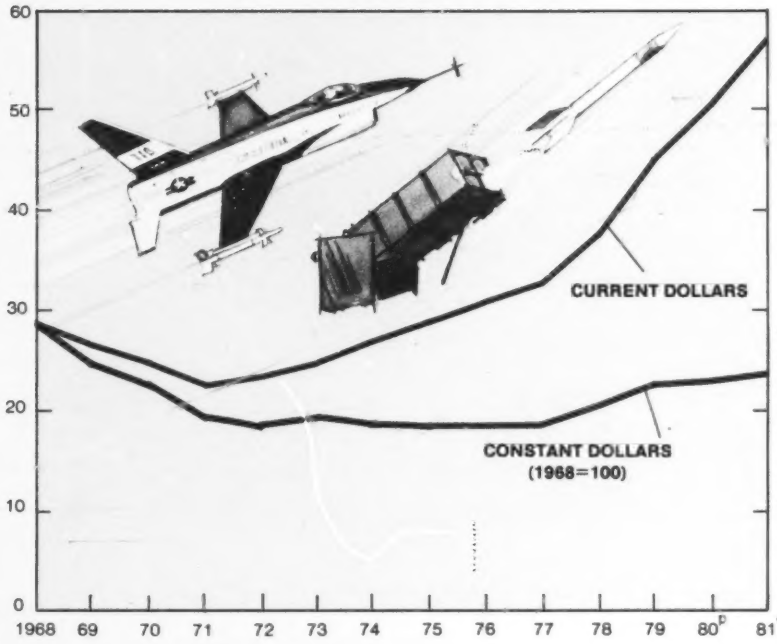
A number of uncertainties obscure the forecast for years beyond 1981, but here is the industry's general view of the 1980s:

Defense. The Administration's stated plans for substantial increases in defense spending augur greater aerospace industry workload. However, the extent of funding increase cannot yet be quantified in terms of aerospace activity. Generally, if Congressional appropriations support Administration plans, the aerospace industry can expect significantly increased defense research, development and production assignments throughout the 1980s.

Space. The Administration's attitude toward civil space development is not yet clear, but in the absence of strong public support no sharp funding increases are expected in immediate years. However, the advent of the Space Transportation System affords opportunities to demonstrate the space benefit potential and to spark new efforts toward commercialization of direct benefit space systems. The industry sees possibilities for an expanded space program in the latter years of the decade, but for the near term space workload should remain at something approximating the current level.

Commercial Sales. The outlook for commercial sales—particularly transport aircraft—is clouded by several uncertainties, such as the future state of the U.S. and world economy; the airlines' financial health; whether air traffic projections—almost double by the end of the decade—will hold up in the face of inevitably rising fares; and whether U.S. manufacturers will be able to retain their current share of the air transport market—more than 75 percent—in light of growing foreign competition. On the basis of the current record commercial backlog, coupled with indications of a somewhat improved airline financial posture in 1981, continuing high levels of commercial sales are expected in immediate future years.

AEROSPACE INDUSTRY SALES
(billions of dollars)

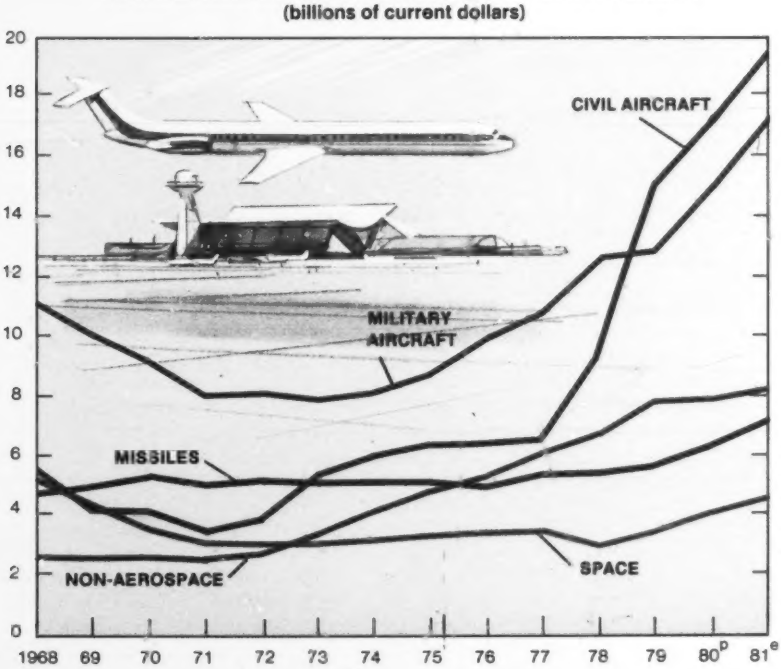


Source: Aerospace Industries Association

p—Preliminary
e—Estimate

The aerospace industry's total sales volume of $50.5 billion included $42.5 billion in sales of aerospace products and services, plus $8 billion in non-aerospace sales. Sales to federal government agencies continued to comprise the major part of the total—54 percent—but non-government sales represented a much greater proportion than a decade ago, when government purchases accounted for more than 75 percent. For 1981, total sales are estimated at $57 billion, which would amount to an increase of 13 percent.

AEROSPACE INDUSTRY SALES BY PRODUCT GROUP
(billions of current dollars)



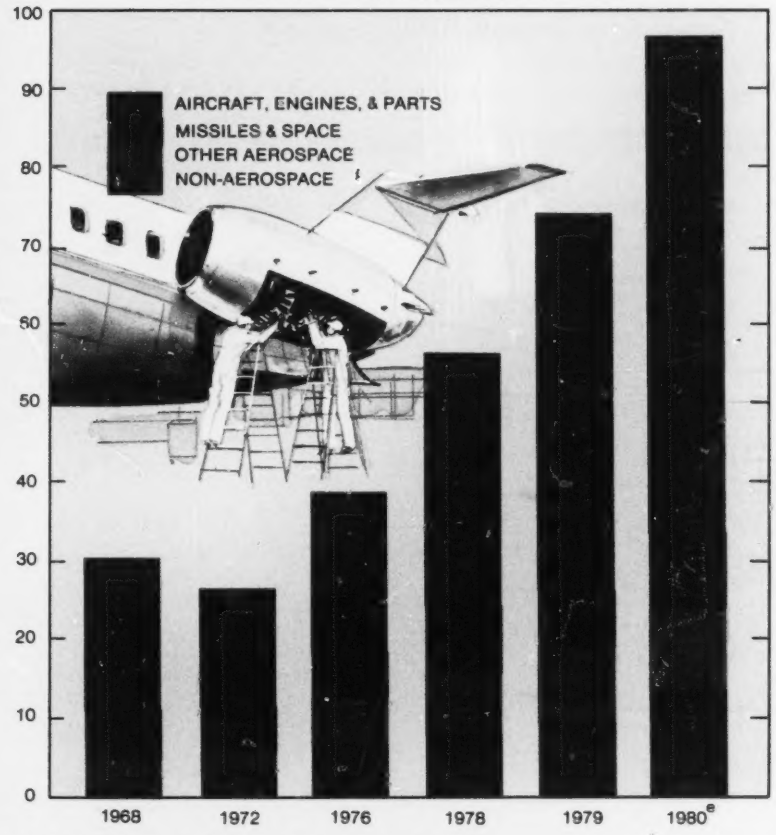
Source: Aerospace Industries Association

p—Preliminary
e—Estimate

The largest single element of the 1980 sales volume was—as is traditional—aircraft production, more than 63 percent of total sales. Sales of civil aircraft outstripped military aircraft sales, continuing a trend in evidence since 1979. Among sales categories other than aircraft, non-aerospace sales (almost 16 percent) led missiles (almost 13 percent) and space (eight percent).

AEROSPACE INDUSTRY BACKLOG, BY PRODUCT GROUP

(December 31, selected years; billions of current dollars)



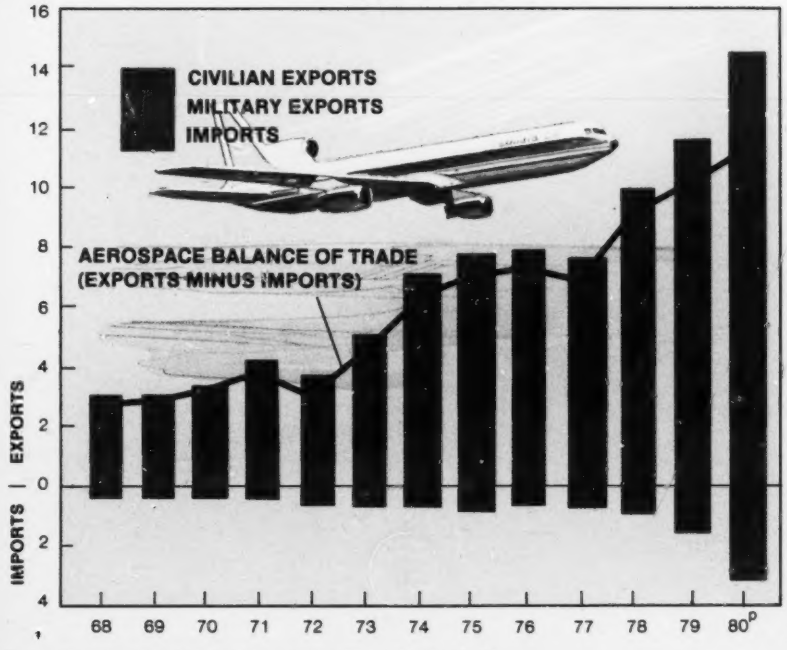
Source: Department of Commerce Data; AIA Forecasts
e—Estimate

Backlog at year-end 1980 topped $97 billion, up 30 percent over the $75 billion on the books at the end of the previous year. The backlog figure reflects escalating prices resulting from anticipated inflation and stretched-out deliveries of commercial transports, but it also includes substantial real growth in new orders. As was true at the end of 1979, the largest segment of the backlog consisted of commercial rather than government orders.

Aircraft, engines and parts constituted about two-thirds of the backlog. A breakdown of other orders shows 14 percent for non-aerospace products and services, 12 percent for other aerospace, and nine percent for missile and space systems. Government orders accounted for the larger share of backlog except in the aircraft, engines and parts category, where civil orders predominated with 68 percent of the total.

AEROSPACE EXPORTS, IMPORTS, AND TRADE BALANCE

(billions of current dollars)



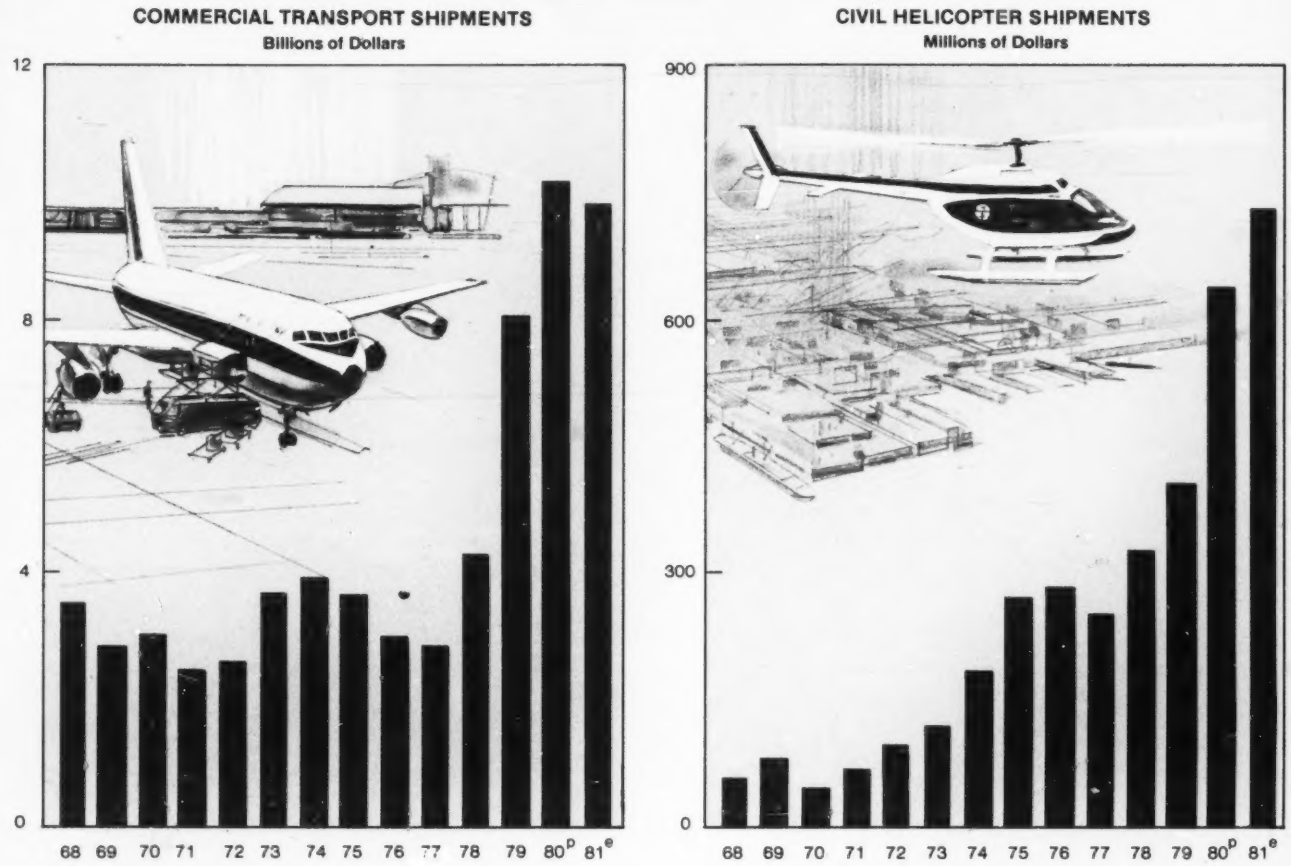
Source: Department of Commerce Data; AIA Forecasts
p—Preliminary

The 1980 aerospace export sales volume was up almost 25 percent, to $14.6 billion from 1979's $11.7 billion; the growth rate surpassed the 17 percent figure of 1979. The aerospace trade balance increased from $10.1 billion in 1979 to $11.3 billion in 1980 and the aerospace industry once again led all U.S. manufacturing industries in terms of export volume and trade balance. Aerospace imports increased significantly—almost double. Some of the import growth is attributable to the 1979 international agreement which eliminated tariffs on imports of many non-military aircraft products. The growing strength of foreign competition was evidenced by large increases in helicopter and commuter aircraft imports.

Civil aerospace products constituted by far the major portion of the export volume. Military exports in 1980 were at approximately the previous year's level, but amounted to less than 15 percent of all U.S. international aerospace sales.

CIVIL AIRCRAFT SHIPMENTS

1968-1981



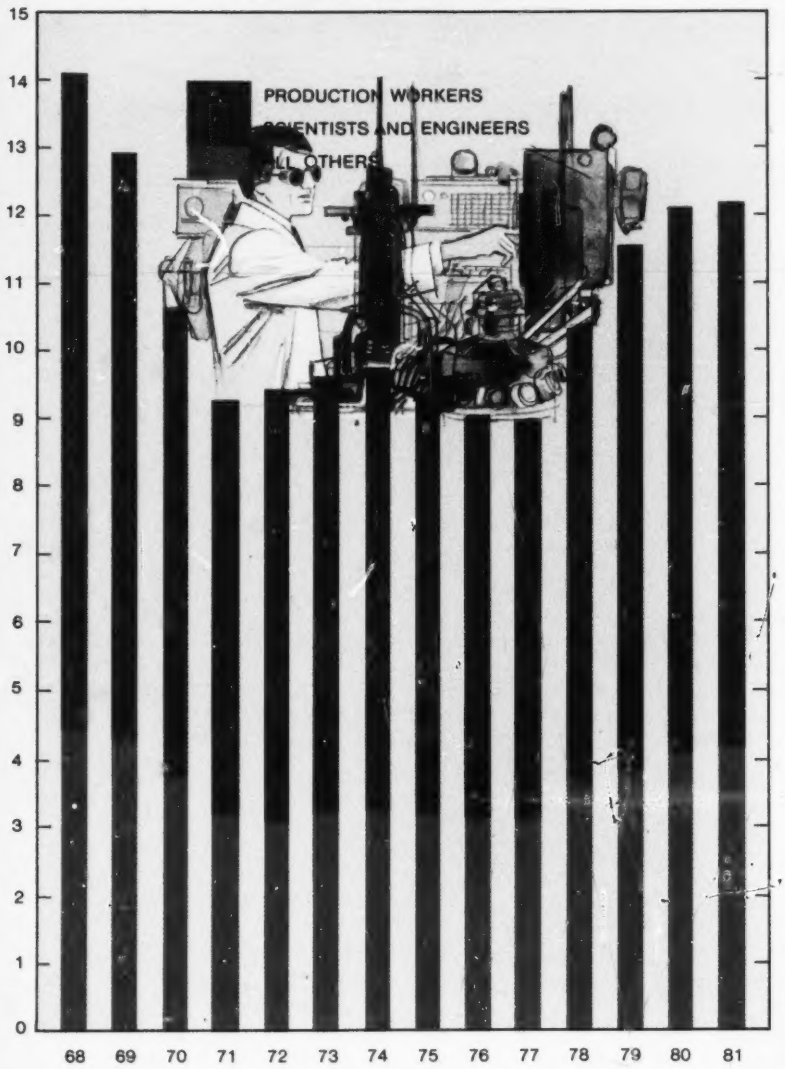
Source: Aerospace Industries Association
p—Preliminary
e—Estimate

Sales of civil aircraft totaled $13.3 billion in 1980, up from $10.8 billion in 1979. Sales of commercial transports, at $10.3 billion, amounted to almost 80 percent of the total. Civil helicopter sales continued to climb sharply, to $640 million in 1980 compared with $403 million in 1979, the previous record year. General aviation sales increased—to $2.3 billion—but at a slower rate than in the decade of the seventies.

In terms of numbers, the industry delivered 415 transports (up from 388 in 1979), 1,272 helicopters (up from 1,019) and 12,004 general aviation aircraft; the latter figure represented a sharp drop from 1979 shipments of more than 17,000 planes. Estimates for 1981 indicate a decline in both numbers and value of commercial transports, continued growth in helicopter sales, and unit shipments of general aviation aircraft at about the 1980 level with a moderate increase in dollar volume.

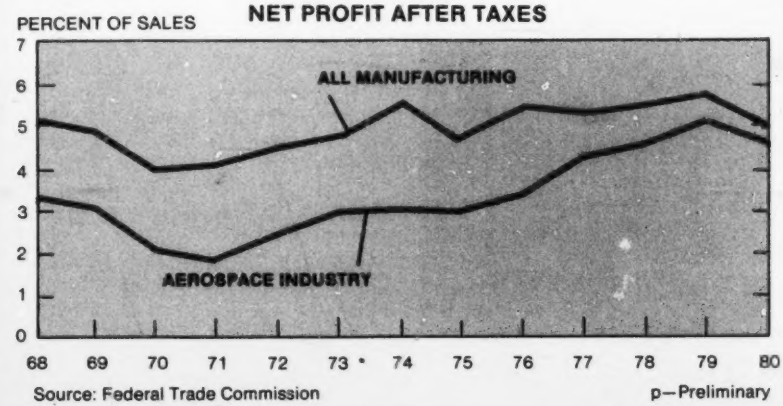
AEROSPACE EMPLOYMENT

(hundreds of thousands of employees)



Source: Aerospace Industries Association
p—Preliminary
e—Estimate

NET PROFIT AFTER TAXES



Source: Federal Trade Commission

p—Preliminary

Aerospace industry employment reached its highest level since 1969 with 1,203,000 in the labor force. However, the growth was only four percent over 1979 and an increase of less than one percent is forecast for 1981. In 1980, the number of production workers increased slightly—about two percent—but increases were greater in other categories: scientists, engineers and technicians up eight percent and other workers up almost seven percent.

The industry's 1980 payroll reached an all-time high of $28.2 billion. Production workers earned $11.8 billion while all others earned $16.4 billion. The earnings increase amounted to 18 percent.

AEROSPACE 1980 HIGHLIGHTS

By JAMES J. HAGGERTY

SPACE

For the National Aeronautics and Space Administration, the operational highlight of 1980 was the November encounter of Voyager 1 with the planet Saturn. Built by Jet Propulsion Laboratory, Voyager 1 produced volumes of new scientific information about the second largest planet in the solar system and returned some 18,000 high-resolution photographs. Among major discoveries, Voyager located three new Saturnian moons and found that Saturn's rings—earlier thought to number only six—were actually a hundred or more separate "concentric features."

The companion spacecraft, Voyager 2, was en route to Saturn to look at the planet from different vantage points and amplify the information provided by Voyager 1. At year-end, Voyager 2 was some 750 million miles from Earth heading for a Saturn encounter in August of this year.

In other planetary exploration, the Pioneer Venus spacecraft—built by Hughes Aircraft Company—continued to orbit Venus and relay radar data for mapping the planet's never-seen surface. More than 90 percent of the surface has been mapped. On Mars, Viking Lander 1—sole survivor of four Martin Marietta-built Vikings—continued to send photos and environmental data from Mars' surface more than four years after its touchdown on the planet.

Among major 1980 civil spacecraft operations,

• NASA's Solar Maximum Mission spacecraft was launched February 14 to study solar flares and their impact on Earth's environment.

• GOES-4, the fourth Geostationary Operational Environmental Satellite operated by the National Oceanic and Atmospheric Administration, was successfully launched September 9. The GOES spacecraft are built by Ford Aerospace and Hughes Aircraft.

• The first of three Hughes-built Satellite Business System spacecraft intended to provide a new range of business communications was sent into orbit on November 15.

• The first of nine Intelsat V international communications satellites was successfully orbited on December 6. Ford Aerospace builds the satellites.

The Space Shuttle, chief among NASA/Department of Defense development programs, made considerable progress during the year. A highlight was the November mating of the three major segments of the first Shuttle—the Orbiter *Columbia,* its large external fuel tank and the two solid boosters. A series of four pre-launch flight simulations was conducted and the Shuttle was moved to the launch pad on December 29. At year-end, all indications pointed to first orbital flight on or close to the target date of March 14. Rockwell International is prime Shuttle contractor.

Other NASA programs in development at year-end included:

• Landsat-D, the fourth and most advanced member of the Earth resources monitoring satellite series, to be Shuttle-launched in 1982. General Electric Company's Space Division is prime contractor.

• Space Telescope, an advanced astronomical observatory capable of looking seven times farther into space than the largest Earth-based telescopes. It will be introduced to service in 1983. Lockheed Missiles & Space Company is spacecraft prime contractor.

• The International Solar Polar Mission, a joint NASA/European Space Agency program to investigate a still-unexplored "third dimension" of space by flying around the Sun's poles rather than in the plane of the ecliptic where all previous spacecraft have operated. Launch was planned for the mid-1980's.

• Galileo, a project involving two spacecraft, one to orbit the planet Jupiter, the other a probe designed to descend through the atmosphere—to be launched in 1985. Hughes Aircraft is NASA's contractor for the atmospheric probe.

• The Gamma Ray Observatory, a new program for long-term investigation of gamma radiations from deep space, an area of astrophysics research so far only lightly explored. At year-end, General Electric and TRW, Inc. were concluding program definition studies.

• The National Oceanic Satellite System, an operational demonstration of a remote sensing system for collecting oceanic data to satisfy both civil and defense needs. Definition studies are being conducted by General Electric Space Division, Lockheed Missiles and Space Company, RCA Astro-Electronics and Rockwell International.

• The Venus Orbiting Imaging Radar spacecraft, intended to amplify information produced by Pioneer Venus; the program is in planning status and expected to be a 1981 start.

In military space operations, the Department of Defense launched two TRW-built FLTSATCOM satellites on January 20 and October 30. They were the third and fourth of a four spacecraft network providing communications links among naval aircraft, ships, submarines, ground stations, Strategic Air Command elements and Presidential command posts. A fifth FLTSATCOM satellite will be maintained as a spare. In development for DoD use is Hughes Aircraft's Leasat, which will relay signals to mobile and fixed air, surface and subsurface stations, and the third generation Defense Satellite Communications System (DSCS-III); satellites for the latter system are built by General Electric Space Division.

Also in development is the Navstar Global Positioning System, a planned network of 18 satellites linked with a control segment and user equipment aboard ships, aircraft, missiles and ground vehicles; the satellites are built by Rockwell International. Navstar GPS is designed to provide precise positioning information for naval, air and ground forces. In 1980, the Air Force launched the fifth and sixth satellites of an interim network intended to validate the concept and check the system's accuracy with several different types of user equipment. The interim satellites will eventually be replaced by more advanced spacecraft and Navstar GPS will be fully operational in 1985.

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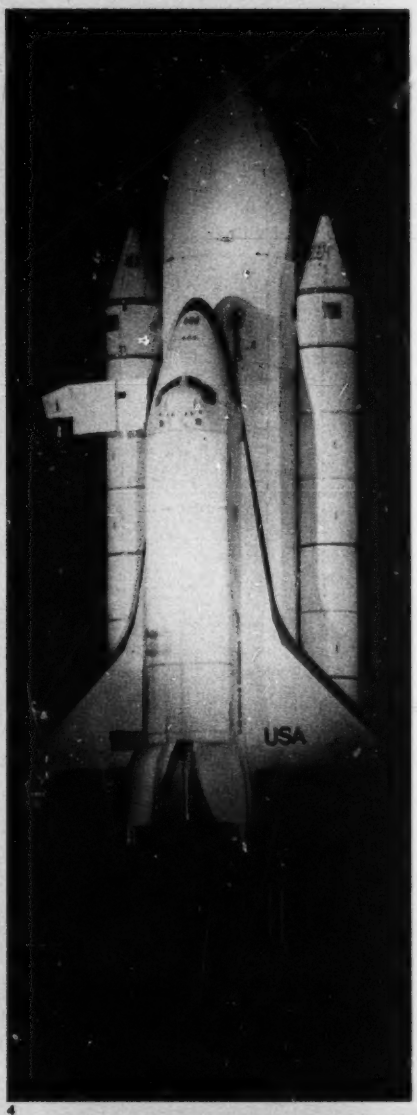

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1. A new view of Saturn's rings taken by NASA's Voyager 1 during its November encounter with the planet.
2. Launched in February, the Solar Maximum Mission spacecraft was designed to study solar flares and other Sun phenomena.
3. Shown in pre-launch checkout is the GOES-4 environmental spacecraft, which was sent into orbit in September.
4. The Space Shuttle was rolled out December 29 to begin countdown toward first orbital flight.
5. Two additional satellites of the interim Navstar Global Positioning System were launched during 1980.

5

DEFENSE

A major 1980 defense development was the selection of Boeing Aerospace Company as prime contractor for the USAF's Air Launched Cruise Missile and the start of production of the AGM-86B missile. Tentative plans called for eventual production of some 3,000 ALCMs, the first to be introduced to operational service in 1983.

Also in production and scheduled for initial operational capability at the end of 1983 was the Air Force/General Dynamics BGM-109 Ground Launched Cruise Missile. In submarine-launch test status was the Navy's Tomahawk, sea-launched version of the BGM-109. In a related project, the USAF and Navy jointly initiated engineering development of the Medium Range Air-to-Surface Missile (MRASM), a derivative of the air-launched Tomahawk cruise missile. First live MRASM live firings from aircraft were scheduled for this summer.

Among other strategic weapons programs, early development and component testing continued on the M-X intercontinental ballistic missile system composed of 200 missiles spread throughout 4,600 shelters. At year-end, there were indications that the new Administration would review the program and consider alternative basing modes, possibly an alternative system.

In production and in operational service was the Navy's Trident 1 fleet ballistic missile, built by Lockheed Missiles and Space Company. The first of the new General Dynamics-built Trident submarines was scheduled for delivery to the Navy in the fall of 1981.

In other missile developments,

- In April, the Army selected Vought Corporation as prime contractor for further development and initial production of the self-propelled Multiple Launch Rocket System.
- A successful first airborne launch-to-target of the Navy/Hughes Aircraft Company Advanced Phoenix air-to-air missile was accomplished in May.
- In September, the Army contracted with Aerojet-General Corporation and Honeywell Inc. for advanced development of the SADARM (Sense and Destroy Armor) missile.
- The Department of Defense approved limited production of the Army's Raytheon-built Patriot air defense missile system in September.
- First live firing of the Advanced Medium Range Air-to-Air Missile (AMRAAM) were conducted in December. Hughes Aircraft and Raytheon are developing competing versions.
- The Air Force/Hughes Imaging Infrared Maverick air-to-surface missile was successfully launched for the first time in December.
- Martin Marietta Corporation began deliveries of test versions of the Army's Copperhead laser-guided cannon-launched projectile for firing tests in early 1981.
- Major military aircraft in production during 1980 included the USAF's F-15 fighter (McDonnell Douglas), F-16 fighter (General Dynamics), A-10 attack plane (Fairchild Republic), the USAF/Navy A-7 attack plane (Vought), the Navy F-14 fighter (Grumman) and the F/A-18 fighter/attack craft (McDonnell Douglas). In limited production, with first deliveries slated for mid 1981, was the USAF/Lockheed TR-1 all-weather reconnaissance aircraft. A new military aircraft, the McDonnell Douglas KC-10 tanker/cargo plane, made its first flight in July and in October the first aerial refueling test was successfully conducted.

A highlight of military helicopter activity during the year was the December first flight of the western world's largest production helicopter, the Navy/Marine Corps/Sikorsky triple-turbine CH-53E Super Stallion. The first six of a planned 49 CH-53Es were in production.

Among other helicopter events of 1980,

- Boeing Vertol initiated a modernization program calling for remanufacture of 436 Army CH-47 Chinooks over a 12-year period. The company also started a similar updating program in which 386 CH-46 Navy/Marine Corps helicopters will be modernized.
- Bell Helicopter Textron introduced the TexasRanger, a military (antitank) version of the commercial 206-L long Ranger; the TexasRanger was developed for the foreign military market.
- Sikorsky completed and extensively flight tested the first five prototypes of the Navy SH-60B Seahawk.

1. The Boeing AGM-86B was selected as the Air Force's Air Launched Cruise Missile and initial production began in 1980.
2. The Navy conducted first underwater launches and boost-to-glide tests of the Tomahawk cruise missile.
3. The Department of Defense approved limited production of the Army's Patriot air defense missile system.
4. Artist's concept shows a transporter delivering an M-X intercontinental ballistic missile to a hardened shelter. The M-X plan calls for 200 transporters, each carrying one misssile, moving the missiles about among 4,600 shelters on a rendom basis.
5. In production and undergoing advanced testing during 1980 was the Navy F/A-18 fighter/attack plane.
6. The USAF's KC-10 tanker/cargo aircraft made its first flight in July.
7. First flown in December was the Navy/Marine Corps triple-turbine CH-53E Super Stallion.

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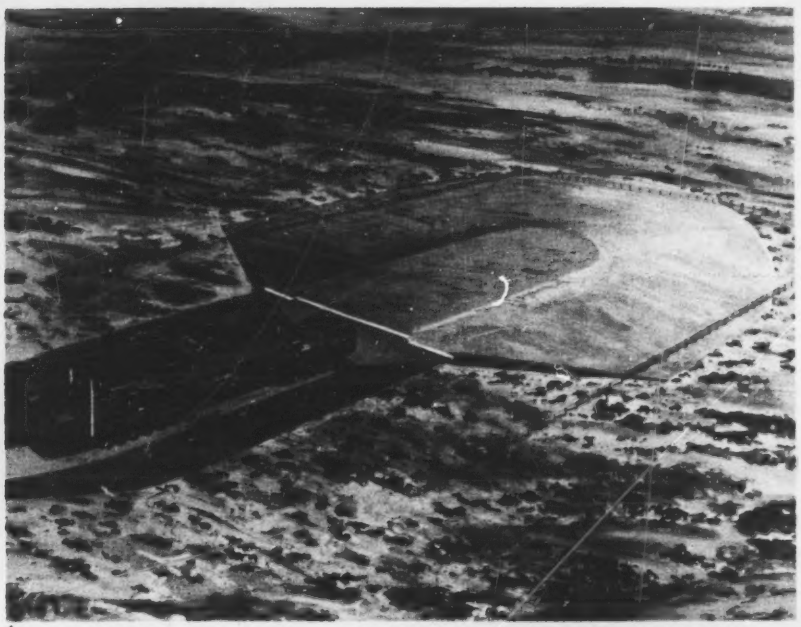

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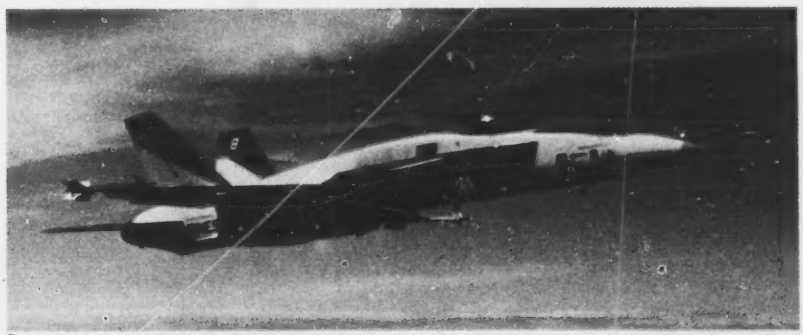

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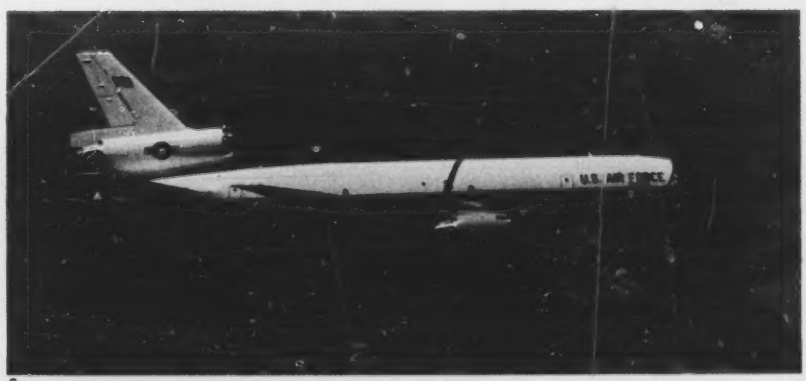

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CIVIL AVIATION

Recession and inflation, the latter highlighted by soaring fuel costs, combined in 1980 to produce the worst operating loss in history and the sharpest-ever annual decline in passenger traffic for the nation's major scheduled airlines. Final 1980 figures show an operating loss approaching $200 million for the U.S. airlines, only the third annual operating loss in their history. The previous operating losses were much smaller —$161,000 in 1938 and $22 million in 1947.

The airlines produced about five percent fewer revenue passenger miles in 1980 than in the record traffic year of 1979—again, only the third such decline in airline history. The previous declines, in 1948 and 1975, were each less than 0.5 percent. Air cargo—mail and freight —held up better in 1980, accounting for a systemwide decline in ton miles of less than two percent.

The Air Transport Association viewed traffic declines and growing cost pressures with special concern because they impede intensive airline industry capital formation efforts. The capital is needed to acquire the quieter, more fuel-efficient aircraft that will best meet the air transport needs of the 1980s and beyond. U.S. airlines have placed orders for $13 billion worth of new aircraft for delivery through 1984—considerably less than the $22 billion that should be allocated for these years to take full advantage of improved air transport productivity.

The Air Transport Association said that significant changes in traffic levels were not expected in 1981, but that improvement in the national economy and greater stability in fuel prices could bring about a return to modest profits.

In the commercial transport segment of the aerospace industry, manufacturers continued development and production of the U.S. family of advanced technology jetliners. In August, McDonnell Douglas Corporation received the Federal Aviation Administration type certificate for the DC-9 Super 80 twinjet transport; airline deliveries began in September. Lockheed Corporation continued production of the L-1011-500 long-range TriStar. The Boeing Company reported on-schedule production of the 767 three-engine transport; the first airplane is due to roll out in August of this year and initial flight is scheduled for fall 1981, followed by certification testing. The 767 will make its airline service debut in the latter part of 1982. Also in fabrication status at year-end was Boeing's 757 twinjet, first deliveries of which are planned for 1983.

U.S. commercial transport manufacturers delivered 485 airplanes during 1980. New orders for jetliners declined slightly from the previous year's figure but the backlog of orders remained at a high year-end level of $21.5 billion.

Sales of U.S.-built civil helicopters reached a new record $640 million and a still-higher level was forecast for 1981. Among the rotary-wing highlights of 1980,

- In November, Sikorsky Aircraft delivered its 100th twin-turbine S-76. By year-end, total orders for the S-76 amounted to 432.

- Bell Helicopter Textron began deliveries of its Model 222 twin-turbine transport. At year-end, Bell was expecting certification and planning to introduce its new four-bladed Model 412, an improved version of the company's Model 212 civil helicopter.

- Boeing Vertol's Model 234 Commercial Chinook, a tandem-rotor high-payload

1. McDonnell Douglas began deliveries of the DC-9 Super 80 following August certification of the advanced technology twinjet.
2. Production of Boeing's 767 trijet was on schedule at year-end; first flight is planned for fall 1981.
3. Boeing Vertol's Model 234 Commercial Chinook made its first flight in August and was scheduled for first deliveries in 1981.
4. The NASA/Army/Bell XV-15 Tilt Rotor research aircraft accomplished more than 100 transitions from vertical to forward flight and reached a top speed of 346 miles per hour.
5. NASA's AD-1 pivoting wing research aircraft was flown at oblique angles up to 45 degrees.
6. The NASA Quiet Short-haul Research Aircraft made a series of landings on the aircraft carrier *Kitty Hawk* to demonstrate the short landing capability of the plane's propulsive lift system.

transport helicopter, made its initial flight in August and certification testing proceeded on schedule. Six Commercial Chinooks ordered by British Airways Helicopters were in production at year-end and the first deliveries were planned for 1981.

In rotorcraft research, a highlight of the year was the performance of the NASA/Army XV-15 Tilt Rotor Research Aircraft, built by Bell Helicopter Textron. The XV-15, whose rotors tilt forward after vertical takeoff to become propellers for forward flight, achieved a top forward speed of 346 miles per hour. Bell completed company testing of the No. 1 XV-15 and delivered it to NASA's Dryden Flight Research Center for further testing; the No. 2 craft was being separately tested at Ames Research Center.

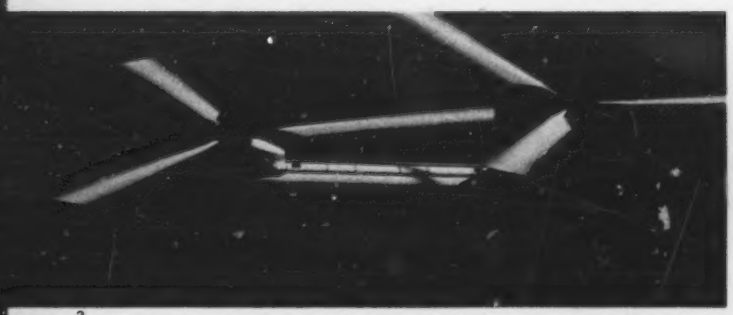
NASA continued advanced flight testing of the Sikorsky-built Rotor Systems Research Aircraft. Also undergoing test was Sikorsky's ABC (Advancing Blade Concept) helicopter. Boeing Vertol's Heavy Lift Helicopter research, terminated in 1975, was reinstituted in 1980 with a NASA contract for development of an advanced transmission.

In other NASA research, flight testing continued on the AD-1 Oblique Wing Research Aircraft, first flown in December 1979. The AD-1 features a wing which can be pivoted in flight, at angles up to 60 degrees, for maximum aerodynamic efficiency; the craft was successfully flown at wing angles of more than 45 degrees. Continuing flight research on the Boeing-built Quiet Short-haul Research Aircraft, designed to demonstrate the propulsive lift concept which will enable tomorrow's short-haul transports to operate from very short runways, was highlighted by a series of landings on the deck of an aircraft carrier. The landings were part of a Navy-NASA investigation of the application of propulsive lift technology to carrier operations.

The Federal Aviation Administration continued to upgrade its Third Generation Air Traffic Control System. The agency commissioned the first En Route Minimum Safe Altitude Warning System (E-MSAW) at the Cleveland Air Route Traffic Control Center. E-MSAW monitors the flight path of aircraft equipped with altitude-encoding transponders for adequate clearance of terrain and man-made obstructions by comparing the aircraft's flight path with a computer-stored grid map of the terrain. The system will be installed at all 20 Air Route Traffic Control Centers in the contiguous 48 states; it is expected to be operational in all 14 centers east of the Rockies by the spring of 1981. A similar system is already operational at 62 terminal areas equipped with ARTS III automated radar systems.

In April, the ARTS III conflict-alert system was commissioned at the Los Angeles tower, marking the completion of a program to equip all 62 ARTS III-equipped terminal areas with a conflict-alert system that warns controllers when aircraft are on converging courses. When the system detects a conflict, it activates a buzzer and flashes the letters "CA" on the controller's radar display. The controller instructs the pilots to take action to avoid the potential danger.

During fiscal year 1980, FAA obligated $688.4 million in airport grants under the Airport Development Aid Program, a new single-year high. Approximately $25.2 million in grants went for construction of satellite airports, to relieve congestion at air carrier airports. In addition, the agency approved 165 planning grants, totalling $10.4 million.



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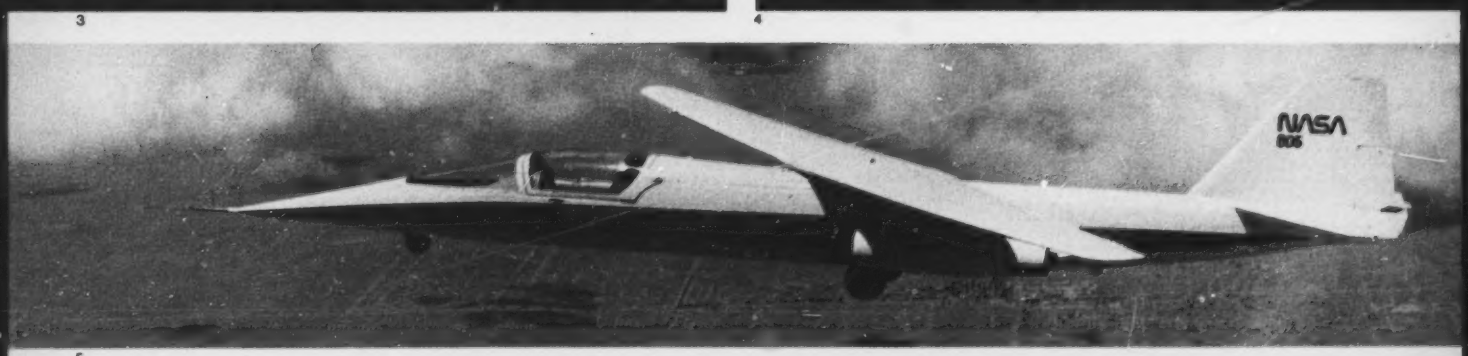

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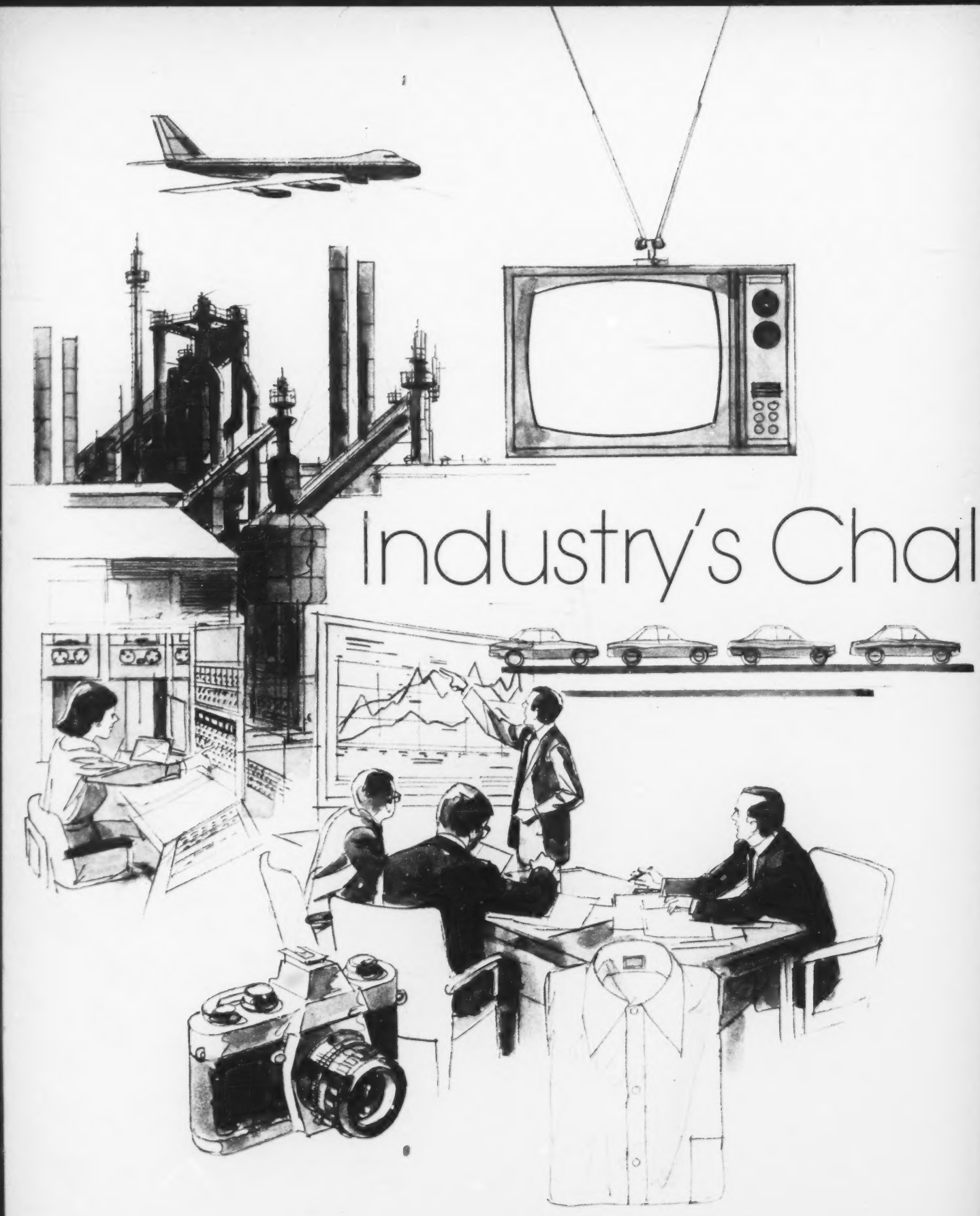

Industry's Chal

BY STANLEY C. PACE,
President, TRW Inc.

enge for the Eighties

I don't suppose it has escaped anybody's attention that this country of ours is in a lot of trouble.

There are several different kinds of trouble that now confront us, but the trouble I'm thinking about is economic. It is compounded of the decline in the competitive world position of U.S. manufacturing industry, the slide of the dollar, our sluggish productivity, the massive invasion of our domestic markets by foreign competition, our low levels of capital investment—all the things that add up to declining prestige and power in the world and a declining standard of living at home.

Anybody who believes that this trouble we are in is just another cyclical low along a rising trend line is in for a rude shock. Something fundamental is happening. We are losing ground against foreign competitors who are beating us at our own game in our own market. And unless we turn it around and recapture our competitive edge and our ability to compete strongly in world markets, a continuing decline in American living standards, security and prestige seems inevitable.

The situation is not hopeless. We have the opportunity to start correcting the errors of the past and pull ourselves ahead in this worldwide competition for manufactured products. But, first, let's describe the problem.

After World War II, the U.S. was not only "ahead," it was "dominant," economically, militarily and diplomatically. This provided us with opportunity for great economic growth. We took advantage of that opportunity. Our economic growth in the fifties and sixties was outstanding. We reaped and enjoyed the benefits. Our individual pay grew, our total affluence grew, our expectations grew —and we became complacent.

During the fifties and the sixties, due to rapidly increasing productivity, each of us received a bigger "piece of the pie" each year, even if we were doing the same work or less. These two decades built expectations which have been hard to change. In the seventies, our productivity growth declined, yet everyone demanded and received at the factory or office a "bigger piece of the pie" each year. But when they put their pieces of pie on the tables at home, they had shrunk. Inflation had taken over. The "bigger piece of pie" received at the factory or office was inflated—yes, inflated with "hot air." By the time it was ready to be eaten, the "hot air" had escaped and the "piece of pie" was much smaller.

All of us are disturbed, frustrated and irritated by this inflation and our inability to achieve our expectations. Let's examine the situation further.

During the fifties and the sixties, we assisted other free nations around the world, both financially and technically. We gave them and loaned them money, and we licensed them our products and manufacturing technology. We taught them our systems and our methods. They learned them. They believed them. They implemented them fully. They built on them and expanded them.

By contrast, we implemented them only partially. The success, growth, the affluence of the fifties and sixties had lulled us to sleep. We had become complacent. We were no longer as hungry as we had been. We began doing "business as usual."

Our foreign competitors were hungry, eager, ambitious, anxious to work and willing to team up. They kept pushing; we relaxed. They have passed us by in many activities and technologies and achievements.

As a result, our U.S. markets are being invaded with good-quality, low-cost, attractive foreign products, from steel to autos to cameras to TVs to clothes to computers. You name the product, and it is either being imported now or it will be in the near future.

They have implemented our systems and our methods. They bettered what we taught them about quality, productivity and market research. They have put this knowledge to work. Now, we must do likewise.

But whose fault is it? Surely, the fault lies elsewhere. Surely, it does not lie with the engineers and managers. Let's check into that.

First, let us look at the government. The federal government must take its

share of responsibility for the present situation. Primary among its sins is permitting inflation—not only permitting, but condoning and exploiting inflation. Also, the government's heavy burden of overly stringent and overly urgent regulation has constituted a major handicap to industry's efforts.

Further, its system of taxation has not created effective incentives for business. For instance, our two major international competitors, Germany and Japan, have no capital gains tax. In the U.S. we tax a company's earnings; then we tax the dividends; then we tax the capital gain on the stock. In my view, this is a deadening *triple* taxation.

Still further, the government seems to have operated for the past two decades in the belief that business is so strong that it can carry any burden that government can impose on it. Recent evidence is convincingly demonstrating that business can be and is being killed by government overload.

It has been said that in the decade of the sixties the federal government almost destroyed the steel industry. In the seventies it almost destroyed the auto industry. In the eighties it is working on the oil industry. Typically, the government's results are disastrous even though its objectives are well-meaning. We must continue to work with the government to improve its results. But let us recognize and accept that the government, although a contributor, was not the primary cause of the present situation.

Second, let's consider the labor unions. They have also caused severe problems, such as very high wages, difficult and costly work rules, featherbedding, inflexibility and anti-business attitudes. However, granting all of that, the unions have been only a contributing problem but not the principal problem.

Third, let's take a look at management. We in management and engineering must pick up the principal responsibility. If we are going to take the credit when we win, we must take the blame when we lose.

So much for the generalities. What about the specifics?

U.S. industry is being overtaken in domestic and world markets by foreign competitors who are surpassing us in the quality of their products, in the efficiency of their manufacturing processes, and in their more marketing-sensitive approach to product design.

With respect to quality, American manufacturers have traditionally aimed at theoretically optimal trade-offs between cost and quality. Our attitude may have been formed in the early 1920s by that master innovator of scientific management, Alfred P. Sloan. Here is what he said:

"In order to gain market share against a competitor, it is not necessary to have greater than competitive quality."

For most of this century, we have followed this dictum and used our domestic competitors for our standards of quality. We viewed such goals as zero manufacturing defects as excessively rigid, unrealistic and puritanical, if not impossible. We thought, surely, that a few percentage points of variance is good enough for most purposes, and we can fix the bad apples at the end of the production line.

So the typical American production line inevitably has numerous quality control inspectors and material review checkers, bins of defective parts, and repair and rework departments. "Make five to get four" may not be the American motto but, unfortunately, it tends to be the American practice.

For most of this century, the system has worked pretty well. We have paid the highest wages in the world and have had the lowest unit labor costs. Our consumer products, including autos, until recently have been—and are in some respects—both inexpensive and of generally better quality and durability than most foreign products.

Now, however, we are confronted by competitors who have recognized that quality is premier, that quality breeds success. They have put it up front, ahead of initial cost consideration, ahead of everything else. They are committed to a goal of no defects, no deviation from specifications. At each stage from product design to production engineering to manufacturing engineering, the goal is to eliminate the possibility of error.

While they are trying to eliminate error, we still accept the inevitability of error and the need to put in the fix after the error has been made. How can they afford to do what they do, we ask, without costing themselves out of business?

Part of the answer is that, when you achieve superlative quality in a product or process, you achieve a lot more along with it. First, you achieve customer satisfaction and that most valuable, effective form of advertising: word of mouth. And it's all free. That means increased sales.

Secondly, you reap important benefits in productivity because truly effective quality permits you to introduce efficiencies in the manufacturing process.

Consider what happened a few years ago when a Japanese firm acquired Motorola Quasar. When the new owners arrived, they found a plant of 1,000 employees producing at full capacity 1,000 television sets a day. The rejection rate was 60 percent, 600 a day. The rejects went to rework stations where they were fixed. It was their way of life. Nobody saw anything wrong with it, *except* the new owners.

A year and a half later, the plant still had the same 1,000 employees, give or take a few, but the rejection rate was down to one percent and the rework stations no longer existed. Production was up to 2,000 sets a day. All of which says that, when you reduce rejects from 600 to 20, you can build twice as many sets. Further, warranty costs were a fraction of what they had been.

What the Japanese did here involved a lot of hard work but no magic and no miracles. It just looks like a miracle. Essentially, what it takes to produce apparent miracles like this is a matter of management philosophy: You have to believe it can be done, and you have to make up your mind to do it—whatever the effort.

The same is true of productivity.

Our most effective foreign competitors understand that they must compensate for their generally-higher-than-U.S. costs in raw materials, transportation and energy by making production facilities as cost-efficient as technology permits.

So, in terms of Gross National Product, the Germans are spending half again as much as we are on industrial plant and modernization. The Japanese are spending twice as much. Since 1970, our rate of productivity increase has averaged 1.3 percent. Germany's has averaged 3.9 percent, Japan's 5.2 percent.

It's not all a matter of investment. It's also a matter of what you do with your investment dollars.

American manufacturers are going to have to attack far more aggressively than in the past the difficult and challenging task of translating advanced technology into marketable products with quality, durability and low cost of manufacture.

Our former foreign students, who are our present competitors, learned from us and now are beating us at our own game. We should, in turn, learn from them and beat them at their game.

The game plan is simple.

First, we must do more and better market research. We must find out what is wanted, what is needed. We have to eliminate the smoke. We have to ignore the easy answers. We have to determine the real market requirements and design our products accordingly.

Second, our product design should determine tolerances wide enough to permit manufacturing and narrow enough to permit good quality, reliability and endurance.

Third, our manufacturing processes and tooling must be designed to produce parts and products to those tolerances, not 4 out of 5 times, but every time.

But I am convinced that U.S. management and engineering can do it, if we accept this challenge as real, if we respond full-out, without reservations, if we set our standards of performance as high or higher than our foreign competition, if we team up with government and labor. In essence, if we get off our duffs and go. So, let's do it.

aerospace perspectives

The following statements are excerpted from "The Ailing Defense Industrial Base: Unready for Crisis," a report by the Defense Industrial Base Panel of the Committee on Armed Services, House of Representatives

Major findings of the Defense Industrial Base Panel:

- "The Department of Defense has neither an ongoing program nor an adequate plan to address the defense industrial base preparedness issue. . .
- "A shortage of critical materials, combined with a resulting dependence on uncertain foreign sources for these materials, is endangering the very foundation of our defense capabilities. . .
- "Present policies and procedures for the procurement of property and services by the Department of Defense are excessively inflexible and discourage the use of contract types that would promote the best interests of the United States. . .
- "Current tax and profit policies appear to discourage capital investment in new technology, facilities and equipment that would increase productivity and improve the condition of the defense industrial base. . .
- "Responsibility for the condition of the base is dispersed among the committees for the Congress and within the Executive Branch; this . . . has contributed to a lack of effective long range planning for industrial responsiveness."

Recommendations of the Defense Industrial Base Panel:

- "Establish a policy for defense procurement that will promote flexibility and permit the use of contract types, including multiyear contract types, that will result in the acquisition of weapon systems and other items in the most timely, economic and efficient manner. . .
- "Specifically authorize multiyear contracting, including contracts for weapons systems. . .
- "Provide that advance procurement of components, parts and materials necessary to manufacture weapon systems may be for a term of not more than five years and that advance procurement may be used to effect economic lot purchases and efficient production rates. . .
- "Recommend to the President that he establish within the Executive Office of the President a point of authority to initiate action . . . necessary to solve the many problems relating to productivity, quality, manpower and critical materials that affect the defense industrial base."

Representative Richard H. Ichord, *Chairman, Defense Industrial Base Panel:*
"One of the things that troubles me most about this situation is the apparent lack of a long-range strategic plan for industrial preparedness at the Department of Defense. We have received testimony that clearly indicates that the Consolidated Guidance—the planning document used by the Department of Defense to establish its force structure—does not even address industrial preparedness. Instead, the Consolidated Guidance sizes our defense production base on the assumption that all future wars will be 'short wars.'. . .

"That seems to me to be a self-fulfilling prophecy. If we plan for a 'short war' and make no plans for a 'long war,' then surely all future wars will be short wars."

William J. Perry, *Under Secretary of Defense for Research and Engineering:*
"We do not have a surge capability; that is, if we wanted to double the production rate of F-16s, in three months or six months, there is no way we can do it. I define that as a surge capability, and we don't have it."

General Alton D. Slay, *Commander, Air Force Systems Command:*
"After nearly 18 months under surge conditions, we could only expect to get an aggregate of 22 more A-10s and no additional F-15s and F-16s than already exist on the currently contracted delivery schedule. Obviously, with proper funding we could greatly increase the output of these aircraft, but we would not begin to see significantly large numbers flying for at least three years or more. . .

"It is a gross contradiction to think that we can maintain our position as a first-rate military power with a second-rate industrial base. It has never been done in the history of the modern world."

Robert Fuhrman, *Chairman, Defense Science Board Task Force on Industrial Responsiveness:*
"Our study indicated that the nation would be short 250,000 machinists in the next five years. We did not see any overall government programs aimed at solving this problem, and the individual company training efforts were only touching the tip of the iceberg. In spite of the recession and its attendant unemployment, there remains a shortage of the skills needed by the defense industry. The shortage leads to competition for labor and an upward pressure on costs."

Harry Gray, *Chairman and Chief Executive Officer, United Technologies Corporation:*
"The supplier network that forms the base of our country's defense industry is shrinking at an alarming rate. Since 1967, the number of companies involved in aerospace production has declined by more than 40 percent. In 1967, there were approximately 6,000 companies in the industry. Today there are only about 3,500."

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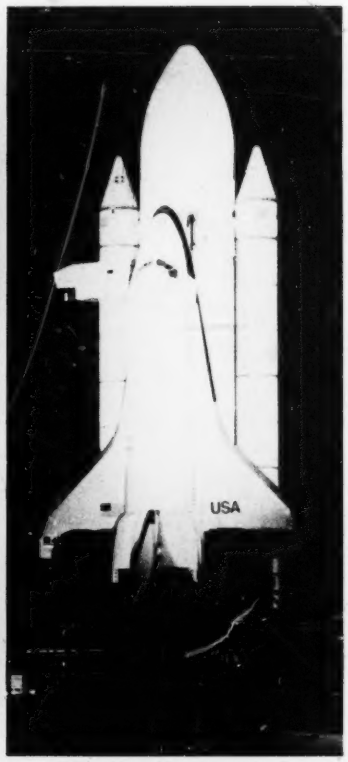

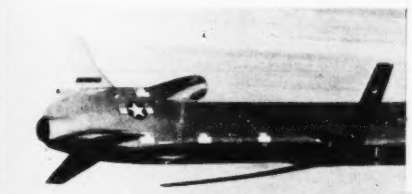

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MANUFACTURING MEMBERS

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Avco Corporation
The Bendix Corporation
The Boeing Company
CCI Corporation
  The Marquardt Company
Chandler Evans, Inc.
  Control Systems Division of
  Colt Industries Inc.
Criton Corporation
E-Systems, Inc.
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McDonnell Douglas Corp.
Menasco Inc.
Northrop Corporation
Parker Hannifin Corporation
Pneumo Corporation
  Cleveland Pneumatic Co.
  National Water Lift Co.
Raytheon Company
RCA Corporation
Rockwell International Corporation
Rohr Industries Inc.
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Sperry Corporation
Sundstrand Corporation
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  Bell Aerospace Textron
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  Dalmo Victor Operations
  Hydraulic Research
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6/10/81 A 0250-1

WHAT'S A SHUTTLE FOR?

notable views of notable people on aerospace matters...

aerospace perspectives

President Ronald Reagan, *in his April address to a joint session of Congress:*

"With the Space Shuttle, we tested our ingenuity once again, moving beyond the accomplishments of the past into the promise and uncertainty of the future . . .The Space Shuttle did more than prove our technological abilities, it raised our expectations once more; it started us dreaming again."

Dr. Eberhardt Rechtin, *president, Aerospace Corporation, speaking before the Armed Forces Communications and Electronics Association's Vital Issues Symposium, held in Washington, D.C.:*

"There is a very natural desire to restrict the use of space to peaceful purposes. Is this a practical possibility? Consider first the use of purely civil satellites. Is the leased use of Intelsat channels for national defense considered peaceful? One could argue that such use constitutes an effective peacekeeping technique. The same reasoning would apply to weather satellites, navigation satellites and remote sensing satellites—whether developed and operated by civilian or military organizations . . .

"Consider treaty verification satellites, which have well served both the United States and the Soviet Union in reducing suspicions and uncertainties about compliance with arms limitation treaties. Should similar satellite assets be denied other countries in the future if their utilization might contribute to peacekeeping? Probably not. On the other hand, any or all of these satellites could be used for tactical military purposes and could be perceived as a threat of one country against another . . .

"Another natural desire might be to secure international agreement to protect satellites from attack. In effect, space would be a sanctuary. But should *all* satellites be in sanctuary—even those that directly aid terrestrial weapon systems? Or should such satellites be as subject to attack as their airborne counterparts? . . . Sanctuary is thus at least as complex an issue as peaceful uses."

Caspar W. Weinberger, Secretary of Defense, *at the Norfolk, Virginia commissioning of the nuclear attack submarine USS San Francisco:*

"Defense and industry have a vital two-way relationship. A strong industrial base, producing the hardware for a modern military in peacetime and able to surge to meet wartime demands, is absolutely essential to the defense of our nation. Our adversaries today know, as our enemies in the past have learned, what the military consequences are of the enormous industrial potential of the United States. It is a trump card we must exploit skillfully.

"At the same time, our significant but carefully planned expansion of American military might can help revitalize and enhance the technological genius and industrial prowess of this, the most powerful nation on Earth. Indeed, our intensified procurement and modernization program is really Defense's contribution to the reindustrialization of America."

Dr. George P. Millburn, *Acting Deputy Under Secretary of Defense for Research and Advanced Technology, discussing "Information Management and Industrial Productivity" at a meeting of the Aerospace Industries Association Manufacturing Committee in Williamsburg, Virginia:*

"During the Agricultural Age, land was a powerful resource. The more you had, the more food you could produce and the higher you ranked on the power scale.

"During the Industrial Age, capital was power. The more you had, the more factories you could build and the more products you could produce.

"The parallel follows through into the Information Age. Whatever level you want to identify within an organization, I suspect the individuals who have the information to make resource allocation decisions are in positions of power . . .

"The concept of the power of information is consistent with the factors which impact industrial productivity. We have all seen the statistics showing the primary factors contributing to increased industrial productivity as capital and technology. By considering technology as information, information becomes a prime productivity improvement factor. This is indeed reasonable, for technology can be communicated. It adds to our knowledge. It forms the basis for judgments and it permits resource allocation decisions to be made. Thus, the challenge to improving productivity involves creating and utilizing both capital and information. We cannot share our capital but we can share our information."

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The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems.

Foster understanding of the aerospace industry's responsibilities in the space-exploration program.

Foster understanding of civil aviation as a prime factor in domestic and international travel and trade.

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

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THE SHUTTLE BONUS

By Karl G. Harr, Jr.
President,
Aerospace Industries Association

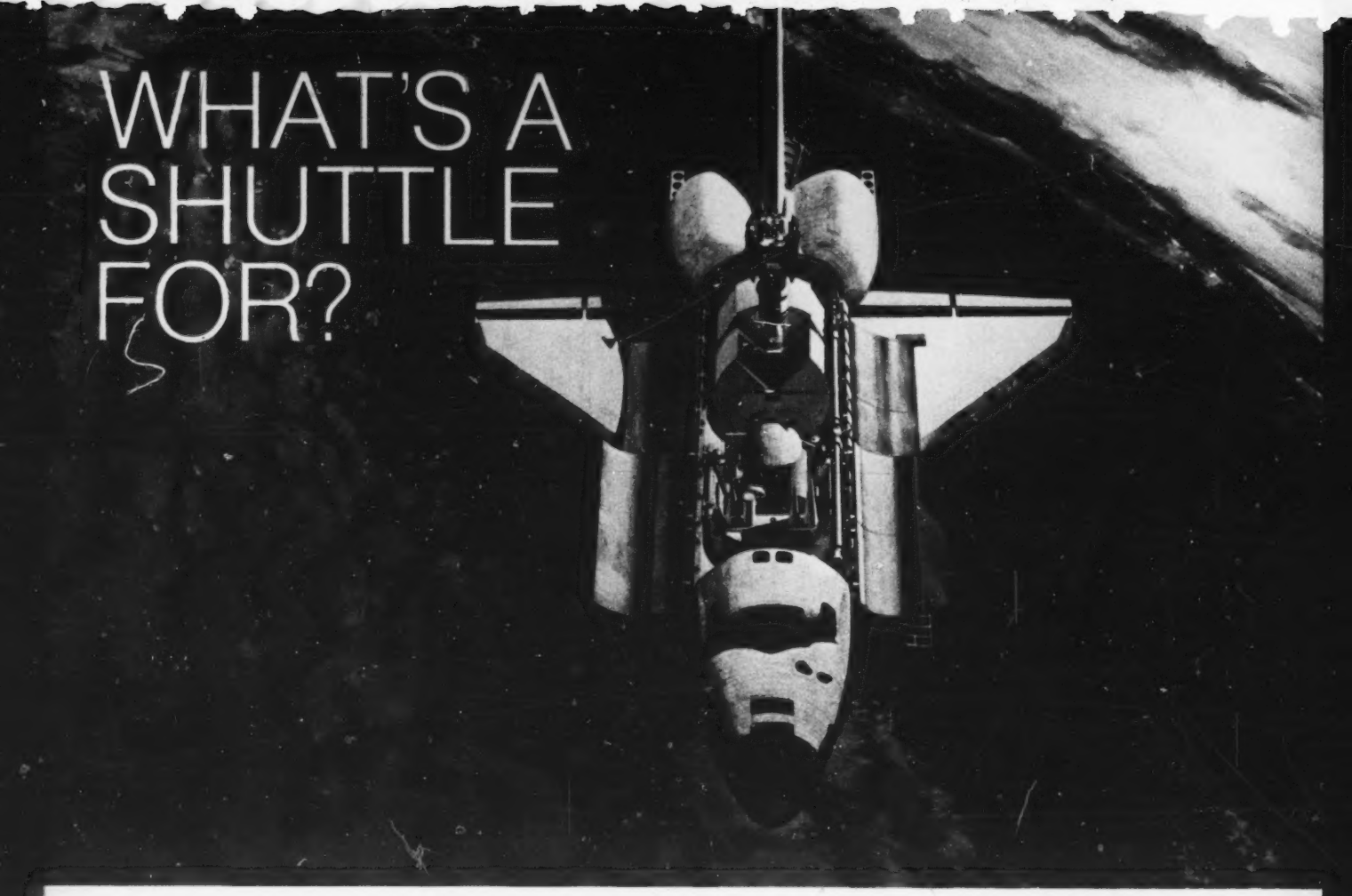
The first orbital flight of the Space Shuttle was the most momentous aerospace operation in recent memory, not simply because of its flawless performance but because of a number of bonus factors.

Columbia's brief voyage in space served to unite in pride an American populace which of late has had little to cheer about. It rekindled public interest in the space potential and perhaps broadened what has been a too narrow space constituency. Most of all, it demonstrated to the world that the United States has not abdicated its scientific and technological leadership.

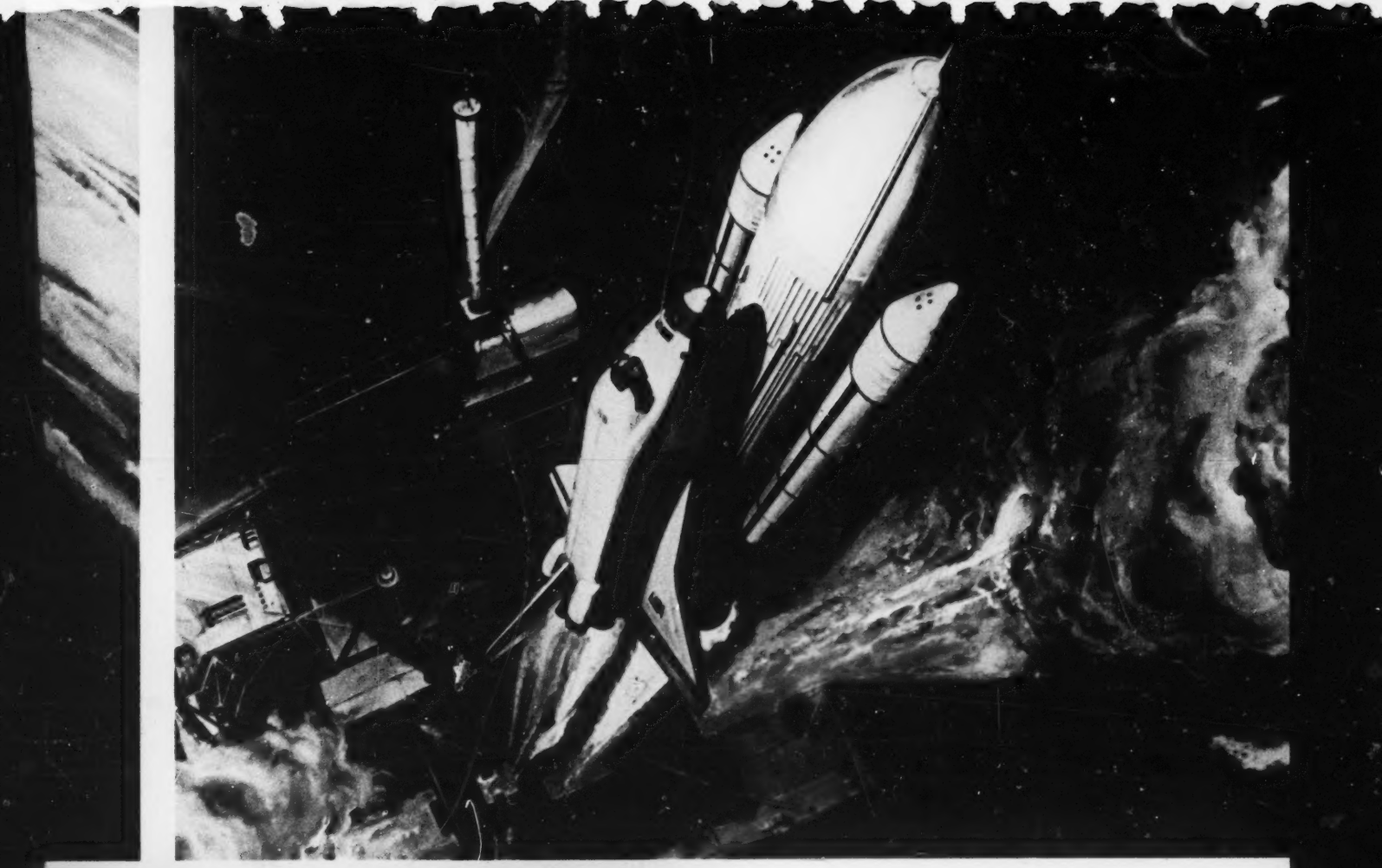
As we bask in the euphoric aftermath of the flight, it is fitting to reflect on what it took to launch STS-1—not just the months of preflight preparation, but the millions of hours of dedicated effort that preceded the Shuttle's arrival at the launch pad. It involved nine years of work on the part of tens of thousands of people in government and industry. Many of the millions of components of the Shuttle did not exist nine years ago. They had to be designed, built and exhaustively tested, then integrated into the most complex aerospace vehicle ever constructed. It was a technological feat that at least rivals, and in many ways surpasses, the development of the Apollo lunar landing spacecraft.

We take pride in the accomplishments of the hundreds of aerospace companies which played a part in the inauguration of the Space Transportation System. And we extend a special salute to NASA's scientists, engineers, technicians and program managers, who surmounted the extraordinary technical challenge in the space of stringent budgetary restrictions. This government-industry team demonstrated that it has lost none of the capability that earlier brought to fruition such programs as Mercury, Gemini, Apollo and the missions to the outer planets. Its efforts inspire confidence that, given renewed public support, our future exploits in space will dwarf the achievements of the past.

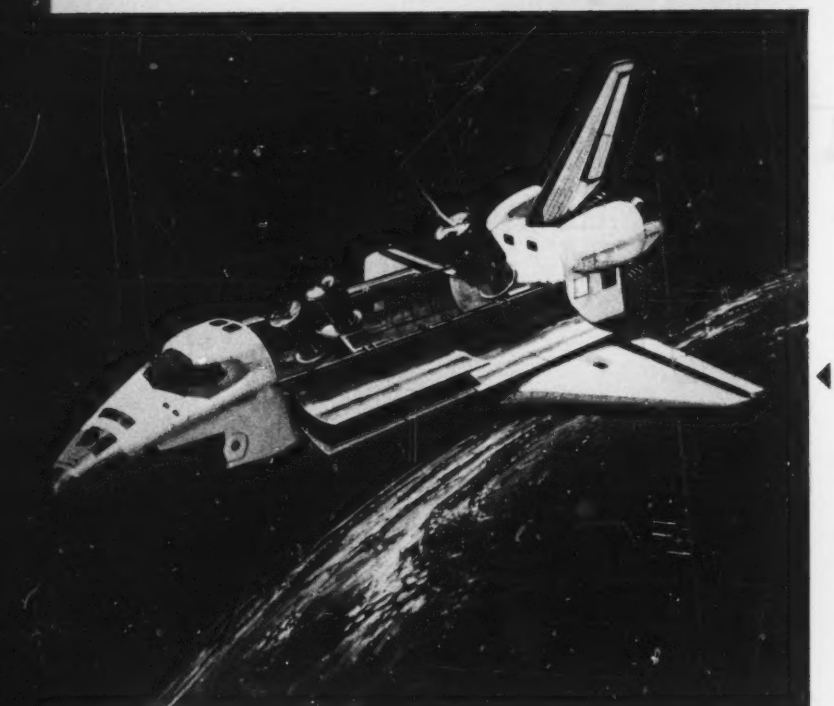
WHAT'S A SHUTTLE FOR?



Published reports make much of the fact that NASA's Space Shuttle is the largest spacecraft ever built, suggesting that its size is the principal factor in its utility. Big it is, about the size of a DC-9, but that's only the beginning, not the end-all, of the Shuttle's capability. A giant step in space technology advancement, the Shuttle differs from earlier space vehicles in that its two major elements—the manned Orbiter and the solid rockets which boost it—are reusable, allowing economical, repetitive use of the equipment and making access to orbit a matter of routine. The Orbiter can operate as a multi-payload delivery vehicle or as a human-staffed laboratory for periods up to 20 days, later 30 to 60 days, and be readied for another trip in two weeks. Such operational regularity will significantly elevate NASA's capability for scientific investigation and benefit-quest, and it will bring a new dimension to the U.S. defense posture. Examples of the new potential for space exploitation afforded by the Space Shuttle are illustrated by the accompanying artist's conceptions, made available to *Aerospace* magazine by Rockwell International Corporation, principal Shuttle contractor.

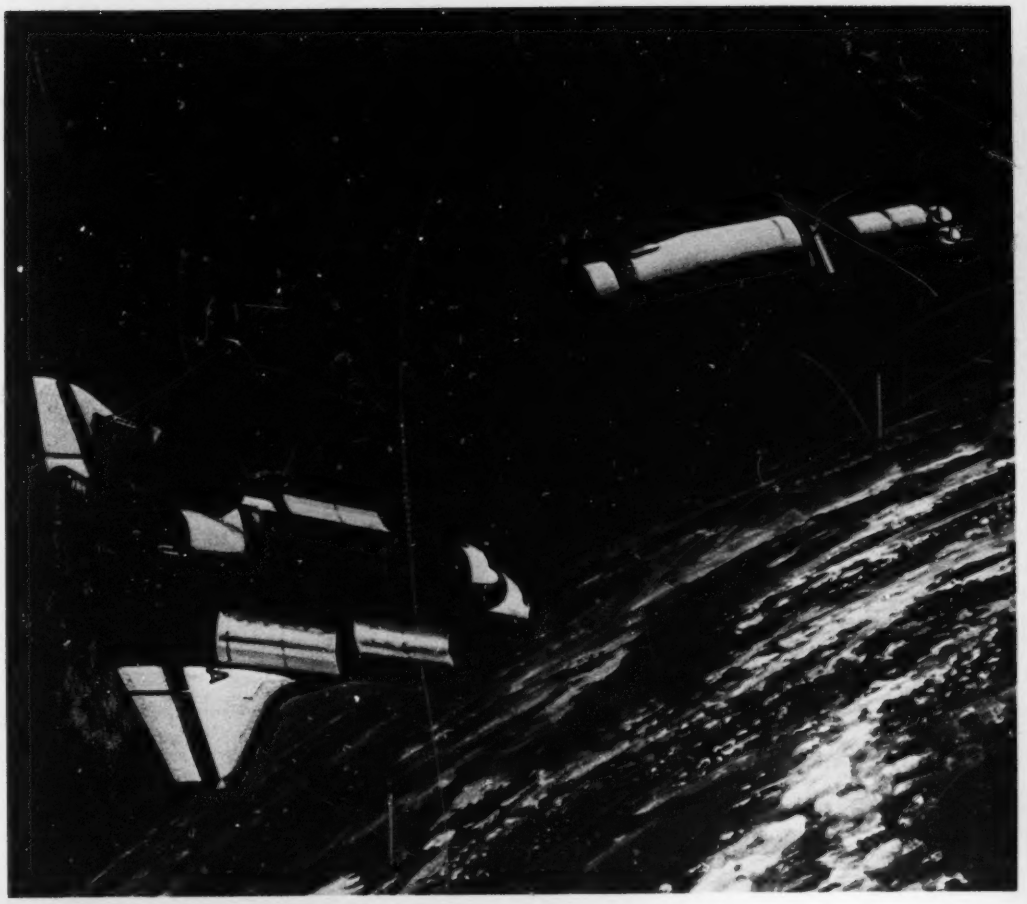


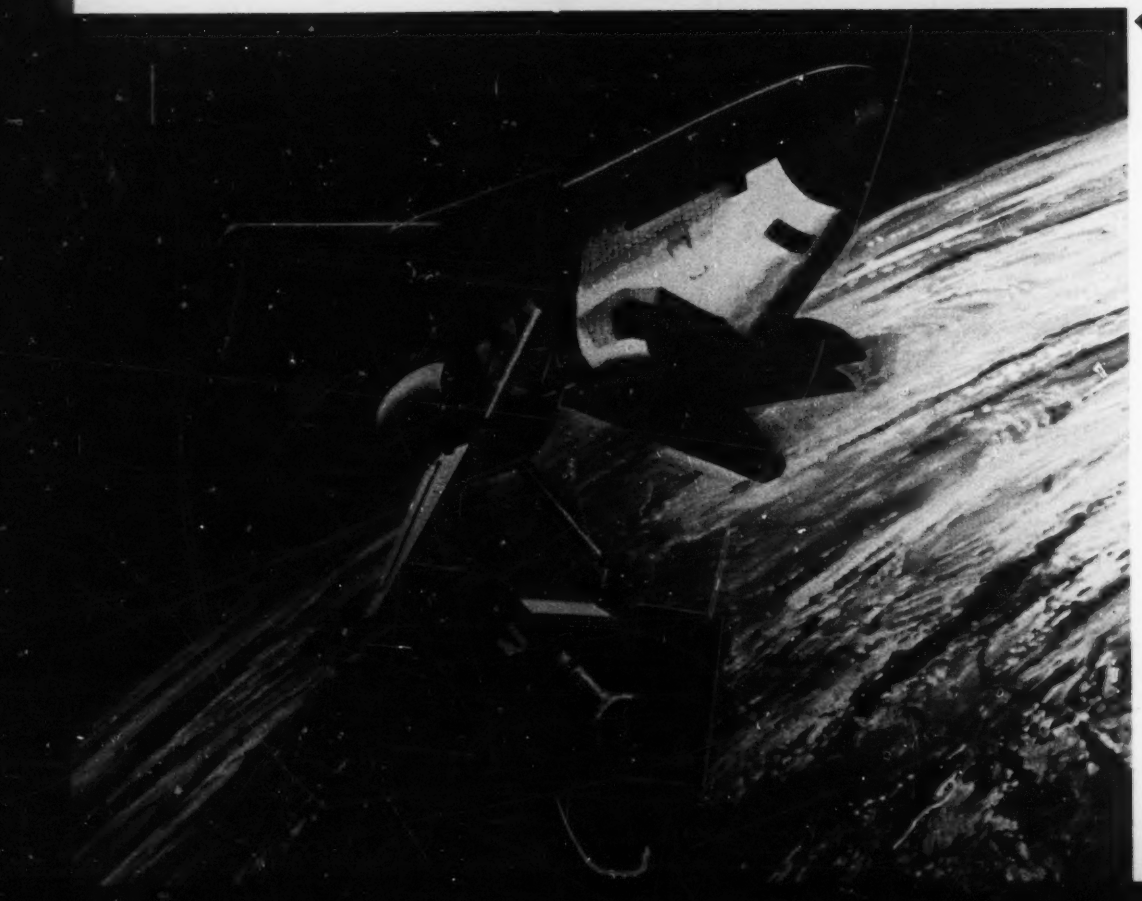
▲ Versatility is the keynote of the Space Transportation System. The Space Shuttle, first and principal element of the system, allows delivery of payloads to any desired Earth orbit, launch of spacecraft into interplanetary trajectories, servicing satellites in space, or bringing them back to Earth for rework. The Shuttle Orbiter, when fitted with its Spacelab component, becomes a laboratory for human-directed experiments in space. Additionally, the Orbiter can serve as a space construction vehicle or as an Earth-to-orbit ferry for support of future manned space facilities.



◀ Principal function of the Space Shuttle will be delivery of satellites to orbit at significantly lower cost than is possible with current one-shot launch vehicles. Shuttle reusability is the major factor in cost reduction. Additional savings accrue from the capability for delivering multiple payloads on a single Orbiter flight, as depicted in this artist's concept. With a volume approximately that of a railroad boxcar, the Orbiter's cargo bay can accommodate several medium-size primary payloads, with room left over for small, secondary experiment packages called "Getaway Specials." Aim of the Getaway program is to allow low-cost Shuttle use by experimenters – such as small companies, educational institutions, research organizations and individuals – who could not afford the cost of a primary payload.

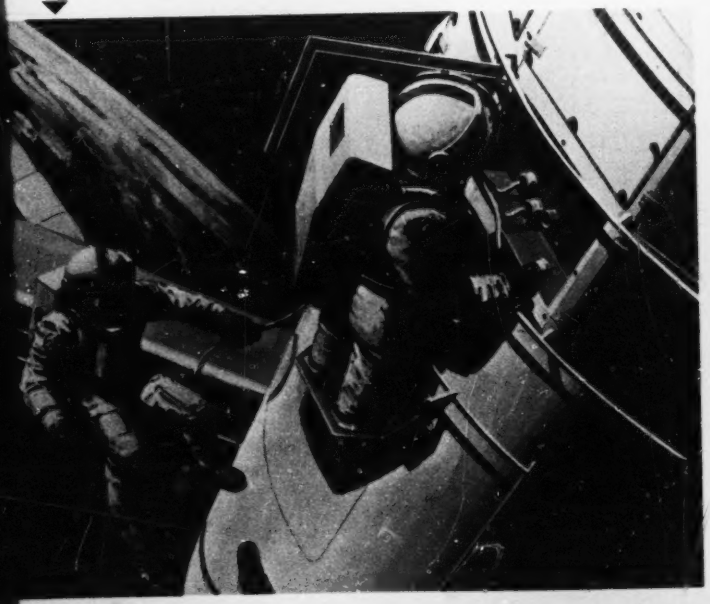
The Shuttle Orbiter is designed to operate in Low Earth Orbit (LEO), altitudes below 600 miles. But many satellites must be placed in Geosynchronous Earth Orbit (GEO) at an altitude of 22,300 miles, where the satellite holds a fixed position relative to Earth because its orbital movement is synchronized with Earth's rotation. To boost a spacecraft from LEO to GEO, NASA and the Department of Defense will employ "upper stages," so called because the Orbiter is the "first stage" booster. The upper stage, or space tug, will also be employed to accelerate planetary spacecraft to the high velocity needed to escape Earth's gravity. In the illustration, the Orbiter has just released a GEO satellite with its upper stage attached; the upper stage propulsion system will be remotely fired when it drifts a safe distance from the Orbiter. Four types of upper stages, for various payload weights and trajectories, are being developed.



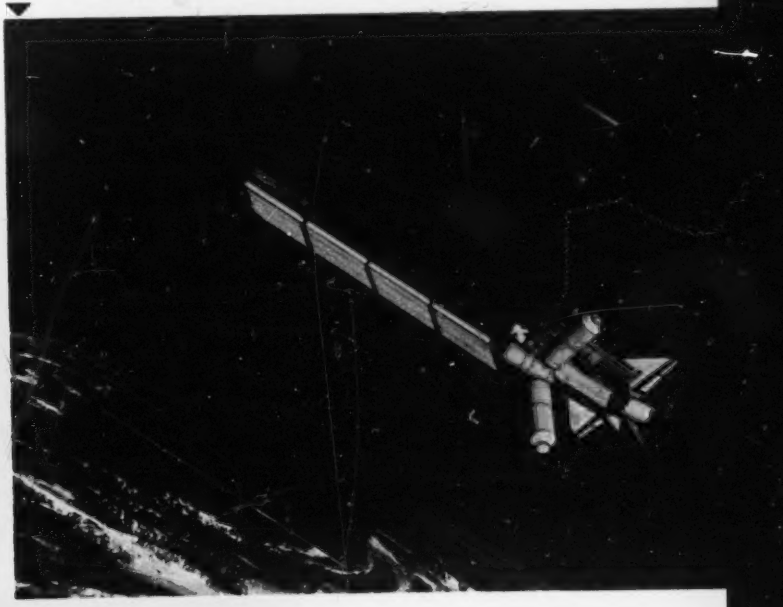


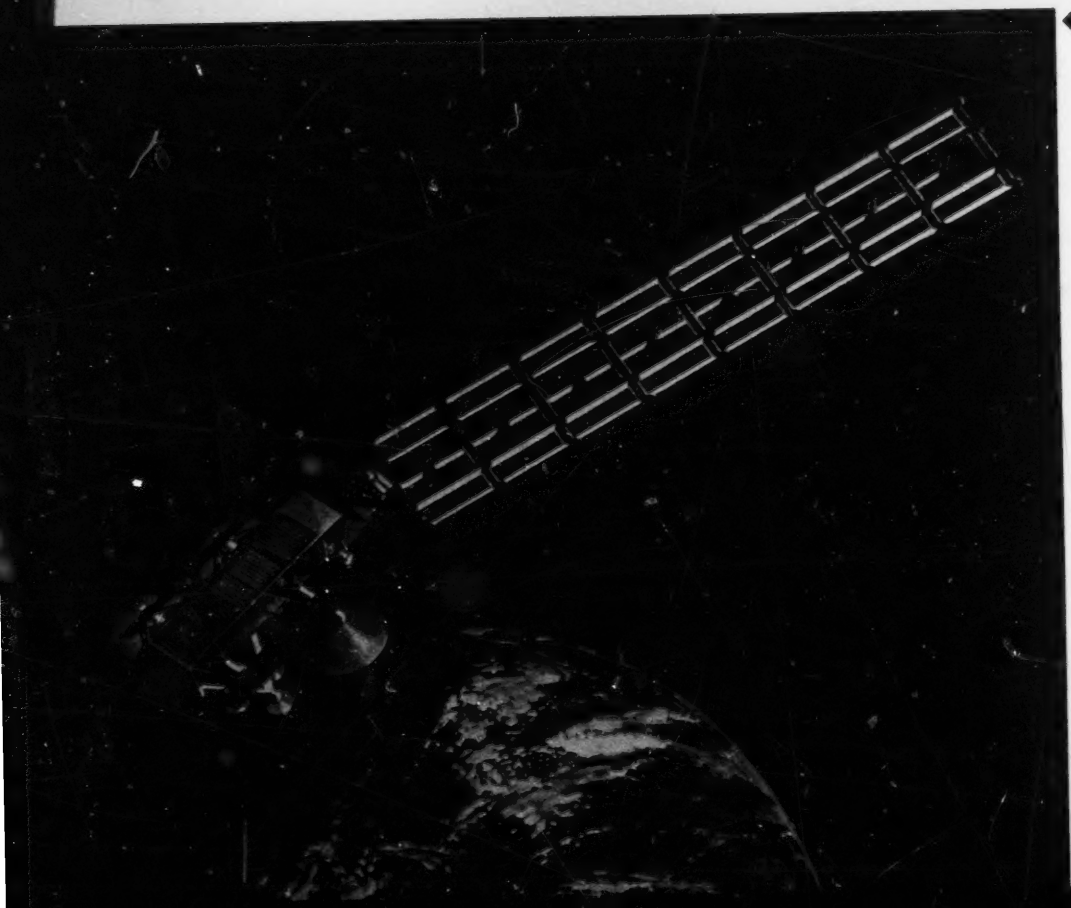
By means of its crew-operated 50-foot robot manipulator arm, the Orbiter can grapple an orbiting satellite, stow it in the cargo bay, bring it back to Earth for refurbishing, and return it to orbit on a later mission. This retrieval capability allows repair of malfunctioning satellites or substitution of more advanced instruments, thereby extending satellites' useful lives and substantially reducing replacement costs.

In many cases, where routine maintenance or minor repair is indicated, satellite servicing can be accomplished in orbit. One method, shown here, is human servicing. Space-suited astronauts leave the crew compartment through an airlock to work on the satellite, which has been "captured" by the robot manipulator arm and stowed in the cargo bay. Another method involves use of an automated "exchange machine," remotely controlled from the crew compartment, which removes an instrument module from the satellite being repaired and inserts a new one. The satellite is then redeposited in orbit.



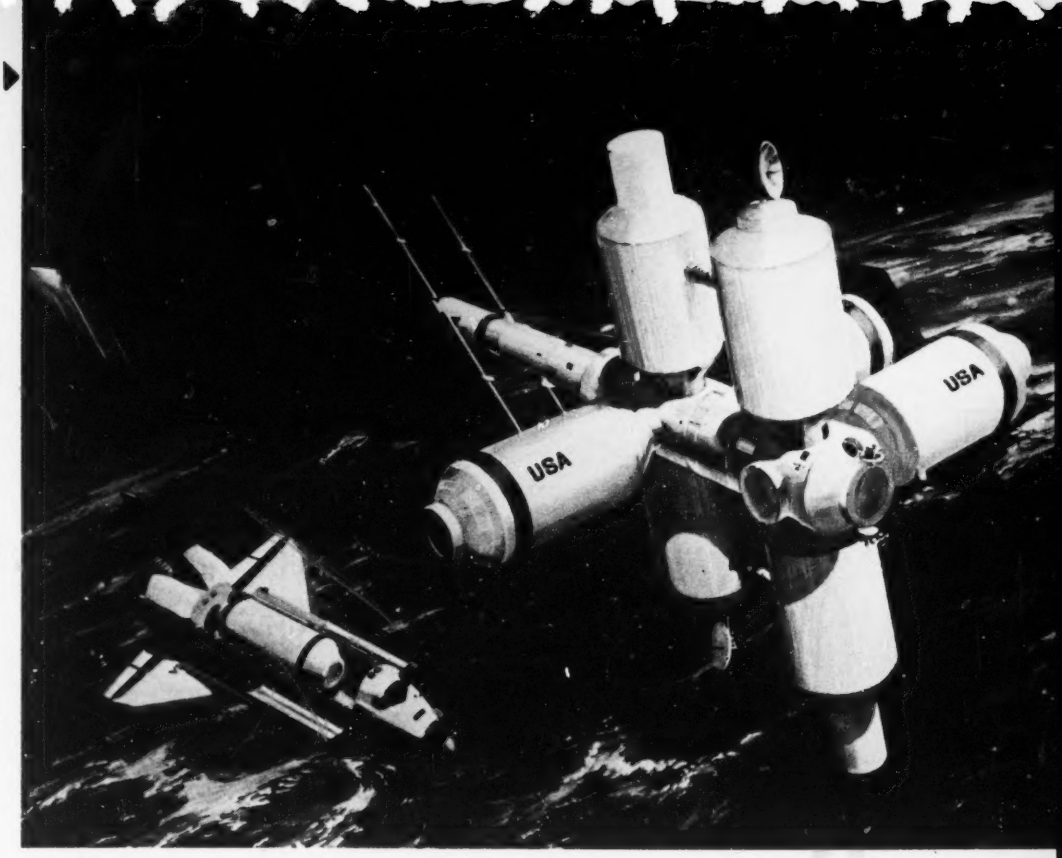
For normal operations, the Shuttle Orbiter has an ample power supply, provided by three fuel cell power plants which generate electricity by chemical reaction. For long missions, NASA is planning development of free-flying solar arrays, or orbiting power stations, of various electricity-generating capacities. The Orbiter would maneuver to a docking with the station to draw upon its power for long-duration operation of Orbiter systems and experiments. Alternatively, experiment modules could be attached to the power station and left there for long periods, freeing the Orbiter to go about other business. Larger orbiting power stations will also supply the electrical needs for future space construction operations.





The Shuttle makes possible a number of new space developments long contemplated but hitherto not feasible. An example is the stationary-orbit platform shown, an unmanned solar-powered facility for long-duration operation of scientific experiments and Earth-benefit applications. The platform will house in a single orbiting package the equipment and functions that now require a number of different satellites. Large platforms will be assembled in Low Earth Orbit from segments delivered on multiple Shuttle missions, then boosted by a space tug to Geosynchronous Earth Orbit.

NASA and its contractors are studying and developing technology for using the Space Transportation System to assemble large structures in orbit. Such structures would serve as human-habitable facilities for scientific study or as centers for operating systems producing direct benefit to Earth's peoples. The illustrated approach to structures erection involves Shuttle delivery of fully-equipped modules which would be docked together to form a facility of any desired size. In another approach, components would be pre-assembled on Earth, collapsed into compact packages for Shuttle transport, and expanded in orbit to their original form. A third technique contemplates in-space fabrication of large girders by means of a Shuttle-mounted automated beam-building machine, the prototype of which has already been developed. The job of joining beams and other components would be handled in part by robot devices and in part by pressure-suited space construction workers.



SPACE TRANSPORTATION SYSTEM CONTRACTORS

The Space Shuttle Orbiter is built by Rockwell International's Space Systems Group, which is also responsible for integration of the overall Space Transportation System. Orbiter and integration contracts are managed by NASA's Johnson Space Center. The other major Shuttle elements include the two solid rocket boosters, built by Wasatch Division, Thiokol Chemical Corporation; the external fuel tank, built by Martin Marietta Corporation; the Orbiter main engines, built by Rockwell's Rocketdyne Division; and the Spacelab, developed by the European Space Agency. These latter contracts are managed by NASA's Marshall Space Flight Center. Other major contractors participating in the Space Transportation System program include:

Abex Corporation	Hydraulic pumps
Aerojet General Corporation	Orbital maneuvering system engines
Autonetics Group (Rockwell)	Shuttle avionics
Avco Corporation	Communications systems
The Bendix Corporation	Instruments, electrical equipment, data processing software
The Boeing Company	Inertial Upper Stage, Shuttle components
Collins Radio Group (Rockwell)	Instruments and displays
Columbus Aircraft Division (Rockwell)	Orbiter components
The Garrett Corporation	Orbiter components, ground coolant unit
General Dynamics Corporation	Centaur upper stage, Orbiter mid-fuselage
General Electric Company	Waste collector, thermal protection adhesive
The BF Goodrich Company	Landing gear wheels, tires, brakes
Grumman Corporation	Orbiter wing and related components
Hamilton Standard Division (United Technologies Corporation)	Freon coolant loop, atmospheric revitalization subsystem, ground support equipment, thermal control equipment
Honeywell Inc.	Launch data processing, instruments, displays and controls
Hughes Aircraft Company	
IBM Corporation, Federal Systems Division	
ITT Cannon	
Lear Siegler, Inc.	
Lockheed Corporation	
Los Angeles Aircraft Division (Rockwell)	
McDonnell Douglas Corporation	
Menasco Manufacturing Company	
Northrop Corporation	
Parker Hannifin Corporation	
Pratt & Whitney Division (United Technologies Corporation)	
RCA Corporation	
The Singer Company	
SPAR Aerospace	
Sperry Corporation	
Sunstrand Corporation	
Teledyne CAE	
TRW Inc.	
Tulsa Division (Rockwell)	
United Space Boosters, Inc. (United Technologies Corporation)	
Vought Corporation	
Westinghouse Electric Corporation	

One type of space station envisioned is the orbital manufacturing facility depicted in this artist's conception. Manufacturing in space offers exciting promise for production of exceptionally beneficial, high-value items not producible on Earth because certain metallic or chemical combinations cannot be mixed or separated in the presence of Earth's gravity and atmosphere. Processing in the airless, weightless environment of space could enable manufacture of metallic superalloys lighter, stronger and more temperature-resistant than any existing materials; pure glass for laser, optical and electronic equipment; flawless crystals for improved electronic systems; or an entirely new class of high-purity pharmaceuticals for more effective treatment of many diseases. The Space Shuttle would link the facility with Earth, transporting people, raw materials and finished products.

Communications systems

Data processing systems

Connectors

Indicators, disconnects, couplings

Crew escape system, reusable insulation, support services

Orbiter components

Spinning Solid Upper Stages (SSUS), launch operations, refurbishment of solid rocket boosters

Landing gear components

Gyroscope assemblies

Orbiter equipment

Fuel cell power plants

Television systems

Instruments, data processing equipment, Spacelab simulator support

Orbiter remote manipulator system

Instruments, computer equipment

Orbiter equipment

Orbiter electrical power equipment

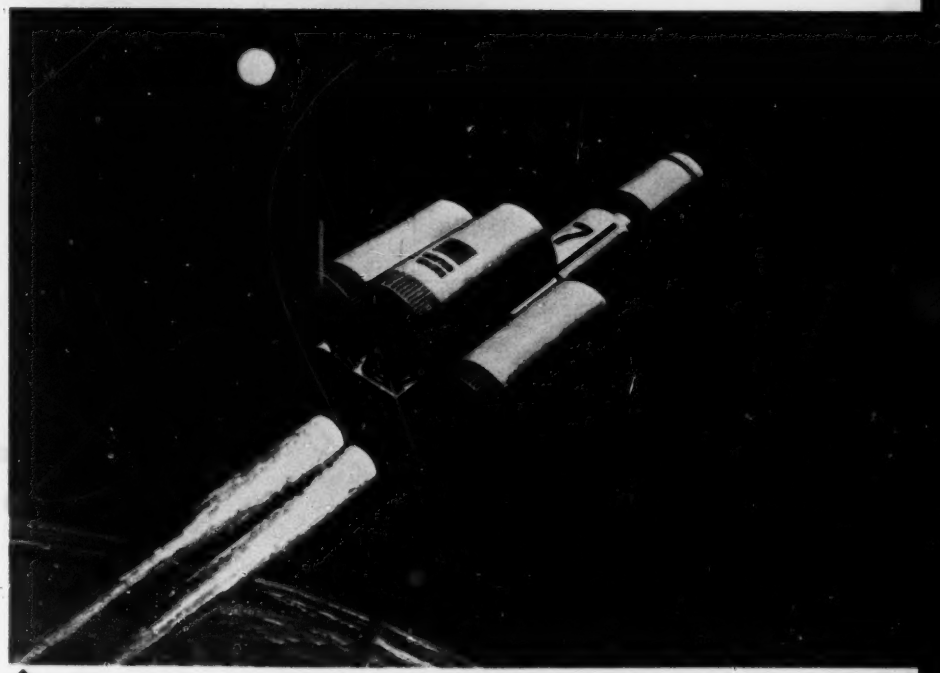
Tracking/data relay satellites, Shuttle communications equipment, Spacelab materials processing systems

Orbiter cargo bay doors

Booster recovery ships, checkout and launch operations, booster refurbishment

Orbiter components

Power subsystems



The interim Space Transportation System consists of the Space Shuttle, the manned Spacelab that fits into the Orbiter's cargo bay, four types of unmanned space tugs, and the Tracking and Data Relay Satellite System, a communications link between the ground and the various operating elements in orbit. Contemplated for later development are such vehicles as manned "cherry picker" space jeeps for construction tasks; high-energy upper stages for moving large structures from one orbit to another; a heavy lift vehicle for delivering payloads heavier or of greater dimensions than the Space Shuttle can accommodate; and (illustrated) large manned orbital transfer vehicles to ferry workers and cargo between Low Earth Orbit and Geosynchronous Earth Orbit.

AEROSPACE COMPETI

A consensus estimate indicates that the world's airlines will spend about $125 billion for transport aircraft in the next 10 years, roughly triple the outlays of the decade past. This unprecedented market has aroused the interest of every nation with an aircraft construction capability, because large airplane orders are big boosts to a nation's economy in terms of National Product, tax revenues, jobs and trade balance contribution.

Since the introduction of American-built jetliners almost a quarter-century ago, U.S. manufacturers have dominated the world market; currently, 87 percent of the jetliners operated by free world airlines are of American origin. U.S. plane builders can be expected to capture a substantial portion of the next-decade market, but the question is *how* substantial. There is reason to believe that the U.S. share will decline, but to what degree is not predictable. Significant erosion of sales, particularly export sales, is a worrisome prospect because of the vital role commercial aircraft production plays in the U.S. economy.

What has brought about the changing international competitive situation? There are a number of factors, among them:

- *Foreign Technical Competence.* U.S. manufacturers dominated the market for decades because their airplanes and engines were technologically superior. But foreign governments, impressed by the economic potential of commercial aircraft sales, have invested heavily, over a long period, in upgrading their technological capabilities. If there still exists a technology gap, it has narrowed to insignificant proportions.
- *Breadth of Competition.* In the early days of jetliner production, competition from abroad involved only the United Kingdom and France. Today, companies from at least a dozen nations, working

VENESS IN THE 1980s

individually or in international partnerships, are considered serious competitors.

- *Development and Production Funding.* Launching a new commercial airplane or engine program demands heavy investment—sometimes billions of dollars—in development and production costs. U.S. manufacturers must finance their own costs. But almost all foreign aircraft producers are government-owned or government-supported companies, and their governments are providing all or major portions of the requisite funding. This gives the foreign competitor a big edge in pricing the airplane.

- *Export Subsidies.* Foreign governments further support their manufacturers by providing a variety of export subsidies to enhance the competitive attractiveness of their aircraft.

- *U.S. Government Disincentives.* On top of the other advantages foreign plane builders enjoy, they are getting an additional boost from U.S. government policies and practices which impose restraints on U.S. manufacturers attempting to sell abroad.

The importance of American competitiveness in the international marketplace prompted recent Congressional hearings on actions the U.S. government might take to improve the competitive posture of its civil aircraft manufacturers. Several of the most important aspects are discussed in the following pages, which contain excerpted versions of testimony by two key witnesses: Dr. W. Stephen Piper, Coordinator of Aerospace Trade Policy in the Office of the U.S. Trade Representative, and T. A. Wilson, Chairman of the Board, The Boeing Company.

AEROSPACE COMPETIVENESS IN THE 1980s: THE OPPOSITION'S EDGE

By DR. W. STEPHEN PIPER
Coordinator, Aerospace Trade Policy
Office of the United States Trade Representative

Support of their manufacturers by foreign governments, coupled with restraints imposed on American exporters by their own government, gives foreign industry a big advantage in competition with U.S. firms.

Dr. Piper was chief U.S. negotiator for the international Agreement on Trade in Civil Aircraft initiated in 1978. His broad background includes service (1974-75) as advisor to the Secretary of Commerce on international aviation matters and as a White House staff member (1975-77) engaged in trade, economic, technical and foreign policy aspects of international aviation issues.

In 1980, aerospace exports amounted to $14.6 billion and accounted for more than 10 percent of all U.S. exports of manufactured goods. Civil aerospace exports totaled $12.6 billion, 85 percent of all aerospace exports. These facts underline the importance to the American economy of the U.S. civil aircraft industry and its ability to compete in the international marketplace.

The export earnings of our industrial products will have far greater importance to the American economy in the decade ahead. In many areas the technological lead of American industry is being effectively challenged by our trading partners. In the face of this challenge, we should not impose restraints on export sales of American products, except under the most limited of circumstances, and where the benefits of such actions clearly outweigh the disadvantages.

In 1978, with the strong support of the aircraft industry, the U.S. government began negotiations to develop an agreement for aircraft trade as a component of the Tokyo Round of Multilateral Trade Negotiations. The only industrial sector pact of its kind, the Agreement on Trade in Civil Aircraft sets forth a multilateral framework to promote a free and fair trade environment for civil aerospace products. But, implementation of this framework notwithstanding, American manufacturers are still somewhat disadvantaged in international markets, not only because of the policies of foreign governments, but more importantly because of impediments that our own government imposes for various foreign policy and national security reasons.

The Competitive Situation

We have become accustomed to seeing U.S. manufactured aircraft—large and small—win the major sales competitions around the world largely because of their economic and technological advantages and because of the quality of service support provided by U.S. manufacturers. However, with the introduction of the four-nation Airbus Industrie consortium, European manufacturers have produced highly competitive aircraft: the current A300 model of the Airbus and the new A310, a head-to-head competitor with the Boeing 767 twinjet transport.

Until now, the Europeans have not been successful in cracking world markets and in establishing competitive support bases; most of their sales have been mandated procurements by national airlines. But with the Airbus, the situation is different. Airbus is generating a world-wide pattern of sales and developing prospects for major reorders. The consortium is positioning itself to secure a strong market position in the 1980s. While the U.S. share of commercial jet aircraft in airline service is 87 percent, the Airbus share of the wide-bodied market—which was only three percent in 1976—grew to 38 percent in 1979.

Airbus represents the major element of foreign competition, but it is by no means the sole competitor. Individually or in partnership, about a dozen foreign

AIRCRAFT IN AIRLINE SERVICE AND ON ORDER BY REGION*

(Numbers in parentheses indicate aircraft on order)

Manufacturer/ Model	North and South America	Europe	Middle East and Africa	Asia and Australia	World Total
Aerospatiale					
Caravelle	19	96	12	2	129
Concorde	—	14	—	—	14
Airbus Industrie					
A300	20 (9)	52(33)	11(19)	35(29)	118 (90)
A310	—	(61)	(18)	—	(79)
Boeing					
707	219	111	114	65	509
720	9	27	30	6	72
727	1,280 (96)	174 (7)	80 (9)	75 (4)	1,609(116)
737	312 (47)	173(49)	101(14)	83(23)	669(133)
747	170 (9)	113(26)	46(10)	130(29)	459 (74)
757	(90)	(19)	—	(3)	(112)
767	(125)	(4)	—	(32)	(161)
British Aerospace					
BAC 1-11	57	88 (3)	4	14	163 (3)
Trident	—	54	—	32	86
BAe 146	(5)	—	—	—	(5)
Dassault					
Mercure	—	10	—	—	10
Fokker					
F-28	16 (3)	32	25	52 (7)	125 (10)
Lockheed					
L-1011	113 (21)	26 (7)	24(11)	31	194 (39)
McDonnell Douglas					
DC-8	227	77	19	54	377
DC-9	477 (73)	296(24)	11	79(14)	863(111)
DC-10	177 (19)	89 (4)	10	52 (4)	328 (27)
TOTALS—in service	3,096	1,432	487	710	5,725
—on order	497	237	81	145	960
Percent of World Total (in service and on order combined)	54%	25%	8%	13%	100%

*Drawn from "World airliner census No. 16", *Flight International*, December 27, 1980. Data as of December 1, 1980.

nations are producing or developing more than a score of competitive commercial aircraft.

The decade ahead is one of unparalleled challenge and opportunity for aircraft manufacturers—with the price of oil being a major catalyst for increased sales. Several thousand aircraft, built when jet fuel cost 10-12 cents a gallon, must now be retired for economic reasons as fuel costs have increased from 12 percent of a typical airline's total operating cost to 31 percent. Overall commercial aircraft sales—which totaled $42 billion in the 1970's—are likely to be on the order of $120-$130 billion in the decade ahead.

In addition to orders for current generation aircraft and aircraft in development—such as the Boeing 757, 767, and Airbus A310—there is a major competition underway for new, fuel-efficient aircraft in the 120-150 seat category. The demand for such aircraft will be great, as they will be the successor aircraft to more than 3,500 planes of several types, mostly Boeing 727s and 737s and McDonnell Douglas DC-9s, in commercial service at the end of last year. The value of this replacement market is estimated at $72 billion.

The demand for commuter services and for commuter aircraft represents great growth potential in the air transport market. Many manufacturers anticipate a worldwide market for 1,000 aircraft in the 20-40 seat range through 1990, with nearly half of this market being in the United States. Foreign manufacturers are moving rapidly to penetrate all segments of the U.S. commuter aircraft market.

The demand for twin-engine business aircraft—both turboprop and turbofan—has remained strong in the past several years of inflation and recession. This growth pattern is expected to continue.

In all of these categories U.S. manufacturers are facing stiff and growing competition.

Foreign Government Support

An important dimension of the competitive situation that U.S. manufacturers face—whether they produce general and business aviation aircraft, helicopters, commuter-size aircraft, or large passenger jet aircraft—is that almost all of the foreign manufacturers are government-owned or government-supported companies, receiving regular government funding for the development and production of civil aircraft. U.S. manufacturers enjoy no such support.

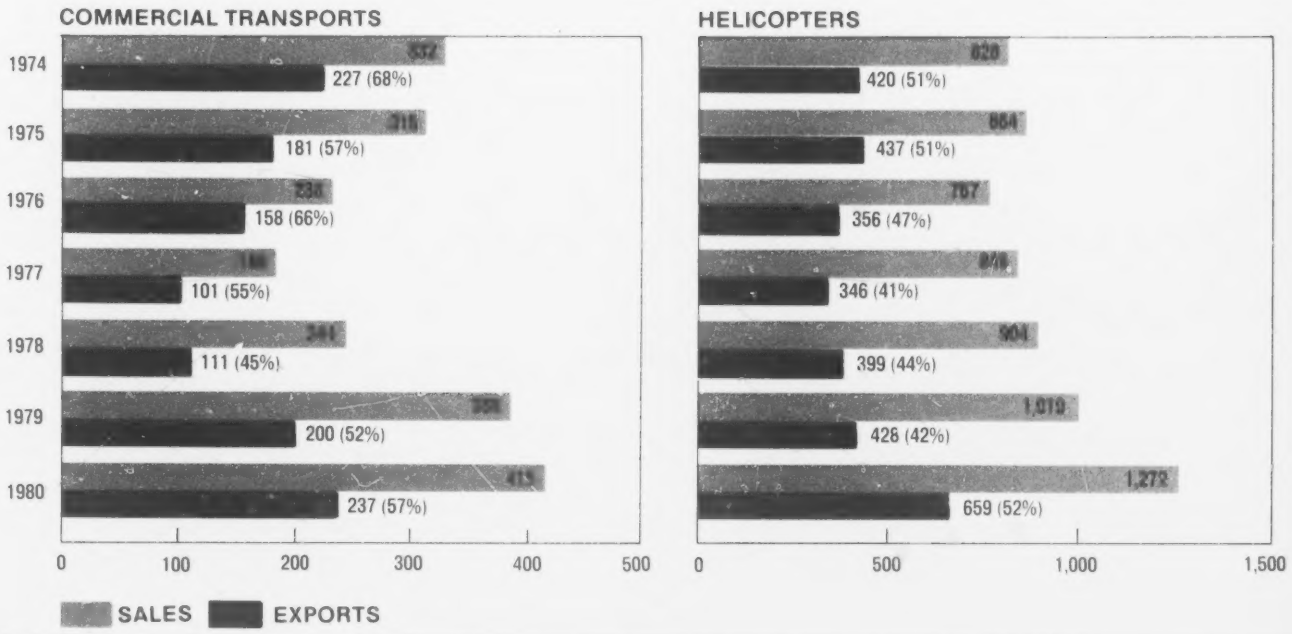
The most prominent government funding program for the development and production of a specific civil aircraft project is the Airbus. Airbus Industrie is owned by the British (20 percent) French (37.9 percent), German (37.9 percent), and Spanish (4.1 percent) governments. Each of these governments, as well as the Belgian and Dutch governments, fund their industries (also government-owned) to produce components for the A300 and A310 aircraft.

They are also funding studies and design effort on new aircraft designs known as the A320-100 and A320-200. A 150-160 seat A320-200 is likely to be the first of these programs, and announcement of a development start could come this year.

Additionally, the French government is providing major funding to SNECMA for development of the CFM-56 engine, a joint SNECMA-General Electric Company project. The engine is a likely candidate for the new generation A320 aircraft under study.

Japan has made an industrial policy decision to establish a civil aircraft industry competitive in world markets and is vigorously implementing that decision. Through its Civil Transport Development Corporation, a consortium of three major Japanese industrial firms, Japan is funding the Y-X project, the Japanese share of the Boeing 767. The government is also supporting studies and preliminary design of the Y-XX 120 to 150 seat transport; a 50-50 project with Rolls Royce Ltd. to develop and produce the RJ-500 jet engine, which could power a 120 to 150 seat aircraft; continuing research and development by the country's National Aerospace Laboratory of a high bypass ratio turbofan suitable for subsonic commercial or military aircraft; and development of a fanjet Short Take-Off

EXPORTS AND CIVIL AIRCRAFT SALES



and Landing (STOL) aircraft.

Here is a partial list of other foreign civil aircraft being developed with government assistance:

- The Netherlands government is backing a Fokker evaluation of an F-29 twinjet transport.
- Sweden is supporting Saab's joint development of the Saab-Fairchild 340 turboprop aircraft with a capacity of 30-34 seats, intended for airline service in 1984.
- The United Kingdom is supporting the new 36-passenger Shorts 360 being developed by the government-owned Short Brothers Ltd. of Northern Ireland for airline service beginning next year.
- The 35-passenger CN235 (C for CASA of Spain and N for Nurtanio of Indonesia) has the support of the Indonesian and Spanish governments. Both CASA and Nurtanio are government-owned companies.
- Aerospatiale of France and Aeritalia of Italy are jointly developing a 42-50 seat commuter aircraft, the ATR-42 targeted for 1985 introduction.
- The Canadian government has provided guarantees for commercial loans to deHavilland of Canada to develop the new 32-seat Dash 8, a head-to-head competitor in the U.S. market with the Brasilia, produced by Embraer of Brasil. Both aircraft are scheduled for 1984 entry into airline service.
- The Japanese and West German governments are supporting development of the MBB/Kawasaki BK 117 twin-turboshaft multi-purpose helicopter.

The Aircraft Agreement

It is pertinent to ask what are we doing, what can we do, to assure reasonable competitive opportunity for private enterprise manufacturers that do not operate on government largess and support. A first step was the 1978/79 negotiation of the Agreement on Trade in Civil Aircraft and the Subsidies Code.

The preamble of the Aircraft Agreement sets forth the general policy objective of establishing an international framework governing the conduct of trade in civil aircraft. Specific objectives include the operation of civil aircraft activities on a commercially competitive basis, and the elimination of adverse effects on trade resulting from governmental support of civil aircraft development, production, and marketing.

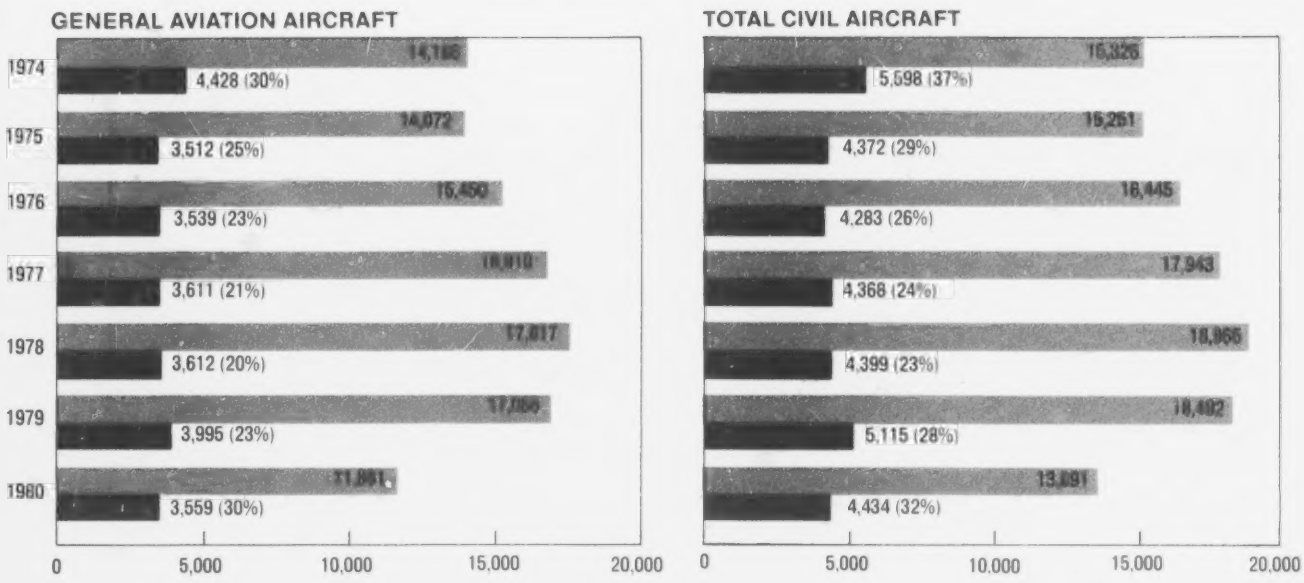
The negotiators of both the Aircraft Agreement and the Subsidies Code recognized that export credit subsidies could distort fair competition, and so provided for the prohibition of such subsidies, defined as grants by governments of export credits at rates below those which the governments actually have to pay for funds. However, the Code allows certain exceptions where export credit practices conform with earlier international agreements.

Substantial problems have arisen in the past year regarding reform of the export credit arrangement. The Administration and the Congress is studying these problems and what actions the United States might take. International competition cannot be fair if some competitors receive subsidized export credits and others do not. Such subsidies need to be eliminated. The only role governments should have in export credit financing is to provide guarantees where they are needed to enable export sales to go forward. Not all exports can be sold on a cash basis, and for many markets our private financial institutions cannot provide the long-term financing required without a government guarantee to cover the political risk.

Export Restraints

Unfortunately, in many cases one or another U.S. policy has hindered, delayed, or prevented a sale of U.S. products. The effect is to encourage or compel consideration of competitive foreign aircraft and to promote sales that our competitors have proven only too eager to make. The consequence is that our foreign competitors then not only have the immediate sale, but also an established toehold to assist in further sales. The U.S. manufacturer finds himself no longer the firm with an established customer base, but the odd-man out, now having to seek sales against an entrenched customer.

There is more competition among aircraft types than is generally recog-



nized. Quite different types of aircraft can be and are used on similar route structures, and route structures can be adjusted to fit fleet procurement decisions. Also, each sale of a present generation U.S. aircraft that is delayed or not made enhances the market available for launching of a new competitive replacement aircraft. By increasing the potential market for a new aircraft, we facilitate our competitor's accumulation of the critical order mass needed to launch such new aircraft programs, and establish our own foreign competition.

The recent experience with delays and uncertainties regarding the issuance of export licenses has caused some airlines to insist that the U.S. manufacturer, not they, bear the burden of obtaining the license. With the lead-time of up to two years involved in producing a large commercial aircraft to customer specifications, substantial nonrecoverable expenditures are committed well before a license application is timely. If a license is then delayed beyond the aircraft completion date, substantial expense ensues from storage costs and inventory financing charges. The latter alone are, at today's prime rate, on the order of $9,000 per day for a single 727.

U.S. Export Trade Policy

Carving out an effective trade policy for the aerospace industry requires diligent efforts on two fronts. We must continue to monitor other nations' adherence to the multilateral framework we have so carefully designed, and we must also work to eliminate those disincentives to trade which are largely self-imposed. Our efforts to achieve a freer and fairer international trading environment for aerospace goods are being matched on the domestic front with a program to mitigate and eliminate a number of domestic disincentives to export trade.

Last September, a Report to the Congress on Export Promotion Functions and Potential Export Disincentives highlighted a number of impediments facing the U.S. exporter, ranging from export controls for foreign policy and national security purposes to codes of conduct including the Foreign Corrupt Practices Act, antiboycott regulations, and antitrust laws. In assembling these disincentives, the report provided a catalyst for review and, as need be, alteration of the current U.S. government practices which have undermined the ability of the U.S. manufacturer to sell overseas.

Desirous of making an effective U.S. trade policy not merely rhetoric but a reality, U.S. Trade Representative William Brock has undertaken an interagency work program to review the domestic disincentives to trade. With respect to export control policy, a policy which has contributed to market losses for the U.S. aircraft industry in more than one key geographic region, the Commerce Department will lead an analysis of the costs and benefits of such policy. Commerce will, in addition, be coordinating the development of an Administration position on a Congressional proposal to establish an independent office of export controls.

The Office of the U.S. Trade Representative is embarked on a program to define the Administration position on an issue which has become extremely important to the private sector, the Foreign Corrupt Practices Act. While we do not question the appropriateness of the objectives of the Act, current ambiguities in the law have transformed it into an export disincentive. Those ambiguities are being reviewed.

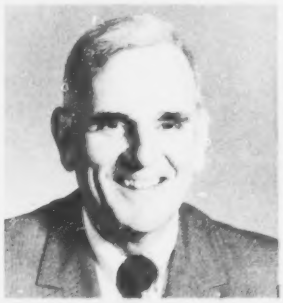
Liberalizing existing tax provisions on overseas earned income is another issue of importance to the private sector; we are coordinating a program with the Treasury Department and Commerce to develop a position on the issue. Similar efforts are underway on consolidation and liberalization of the dual antiboycott statutes, antitrust issues, strategies for efficient use of Eximbank resources, and development of a U.S. government position for the resumption of the international negotiations on export credits.

In the Office of the United States Trade Representative, we recognize that we must put our own house in order by working to mitigate the deleterious impact of various U.S. government practices. In conjunction with our efforts on the international front, we expect that such activities will improve the ability of the U.S. manufacturer to challenge effectively the foreign competition in an increasingly competitive international market.

AEROSPACE COMPETIVENESS IN THE 1980s:
THE EXIMBANK FACTOR

By T. A. WILSON
Chairman of the Board,
The Boeing Company

Strong support by the U.S. Export-Import Bank is vital if American exporters are to match the low-interest deals offered by government-backed foreign competitors.



A leading industry spokesman on aerospace economics and international trade, Mr. Wilson has been with The Boeing Company since 1943. He was closely associated with the company's B-47, B-52 and Minuteman ICBM programs and was responsible for initiating the 757 and 767 jetliner developments.

The U.S. Export-Import Bank plays a vital role in foreign trade. It is the only medium available to U.S. exporters to counter the low financing rates and terms offered by government-supported foreign competitors.

Thus, I am deeply concerned about the proposed reduction of Eximbank's lending authority. The Boeing Company I represent recognizes the need to reduce government spending and curb inflation. But there is reason to believe that the severe cuts being recommended may prove counterproductive at a time when the U.S. export posture is so important to our overall economy.

Boeing was the Number One exporter in the United States in 1979 and may have been in 1980. The company is proud of its achievements in helping to reduce the nation's unfavorable trade balance and pleased that its foreign sales are generating many thousands of jobs throughout the United States. However, without Eximbank support many of Boeing's sales during the past two years would not have been realized.

Our forecasts indicate that the total open market for commercial jet transports during the next 10 years amounts to $122 billion in constant 1981 dollars. We estimate that 60% of these sales—or about $73 billion—will be made to non-U.S. airlines. This ratio of foreign to domestic sales is consistent with historical patterns. Since 1950, U.S. airlines have purchased equipment worth $73 billion and foreign airlines have purchased $93 billion worth.

The commercial airplane market has always been a high-risk, extremely competitive business. The nature of the product requires a heavy front-end investment in research and development, extensive production facilities, and the financial resources to maintain production and administrative requirements over a number of years until the aircraft enter service in sufficient numbers to recover costs.

Because of the multibillion-dollar investment required to launch a new airplane program, large unit sales are required to make the program economically viable. A private-enterprise firm must achieve a positive return on investment to remain in business, and this requires a customer base of global dimensions. Few American industries are so heavily dependent on foreign markets as the commercial jet transport manufacturing business.

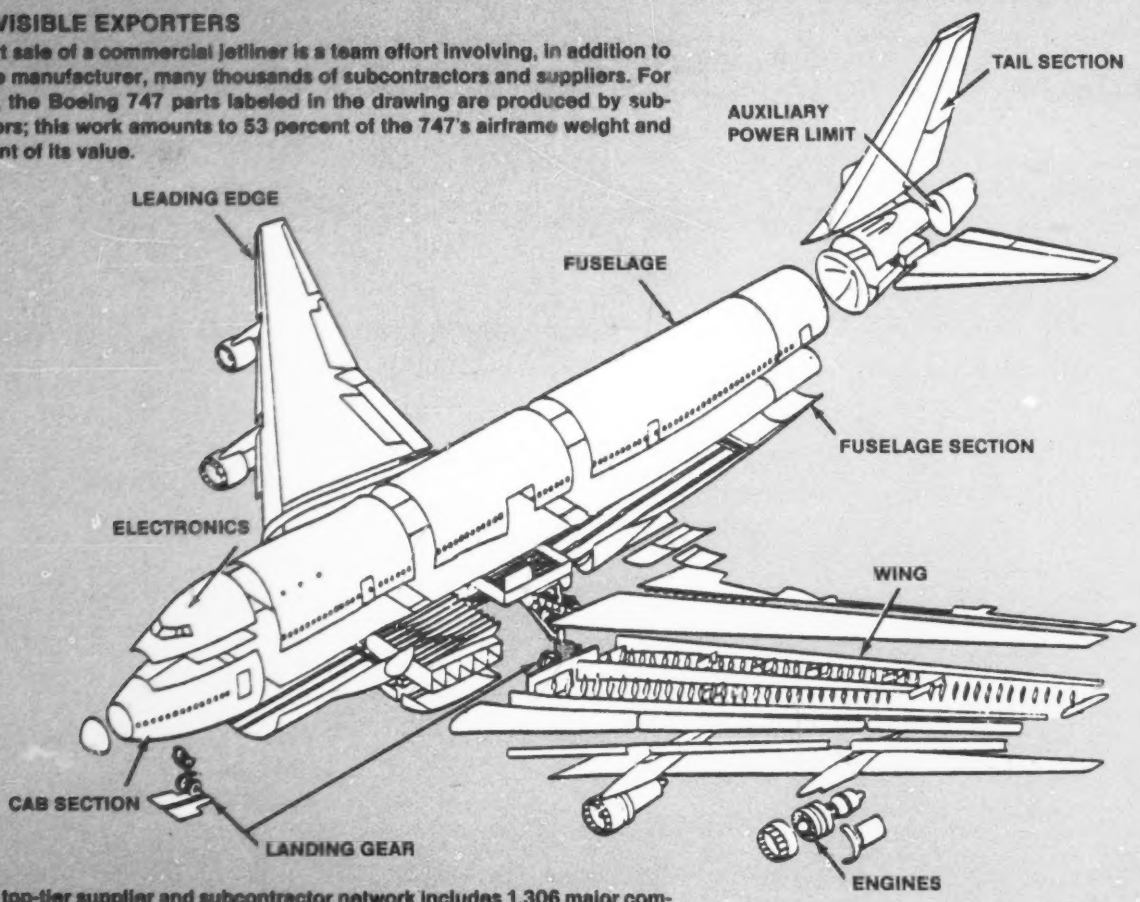
The Changing Competitive Scene

For many years, the jet transport market was a U.S. preserve. American products were technologically superior to foreign equipment. Now that situation has changed dramatically. We have recently encountered tough competition from Airbus Industrie, which is moving aggressively to improve its strong second-place position established in 1979 and 1980.

Airbus, which builds the A300 series aircraft, is solidly backed by the governments of France, Germany, and the

THE INVISIBLE EXPORTERS

An export sale of a commercial jetliner is a team effort involving, in addition to the prime manufacturer, many thousands of subcontractors and suppliers. For example, the Boeing 747 parts labeled in the drawing are produced by subcontractors; this work amounts to 53 percent of the 747's airframe weight and 70 percent of its value.



Boeing's top-tier supplier and subcontractor network includes 1,306 major companies and 2,247 small and minority businesses in 44 states. In addition, there are an estimated 50,000 second and third-tier suppliers. These are the "invisible exporters," who participate in the initial sale and continue their own exports of maintenance and repair parts throughout the useful life of the airplane.

United Kingdom. Because of the subsidy practices of these governments, Airbus is not faced with generating a profit to remain in business and there is no indication that it is profitable. Nevertheless, the A300 and A310 jet transports are very good airplanes and we are acutely aware of the financial resources and the political support provided Airbus to advance its world competitive position.

U.S. manufacturers of jet transports are facing an internationalized public corporation. The political and economic resources of five European governments have supported the research, development, testing, and production of Airbus over an extended period. This multigovernment support is continuing with subsidized export financing U.S. private industry cannot meet without Eximbank help.

The loss of the first order has long-range ramifications. Airlines generally standardize on their initial choice. For example, the initial orders for the Boeing 707 jetliner totaled 169—but the follow-on orders brought the production run to 723 commercial deliveries. The benefits of fleet commonality, which include such things as spares requirements and crew training, make it difficult to justify changing model types. Airlines generally continue purchasing airplane types already in their fleets.

Winning the initial sale provides entry to follow-on business, but losing the order means the entire market for spares and follow-on equipment is eliminated for 15 to 20 years. At the present time, Boeing is facing a critical period for first orders. Our 757 and 767 aircraft are competing with the A310 around the world.

The loss of foreign sales has a negative effect on the nation's balance of payments. The commercial airplane industry has contributed more to a positive trade balance—about $35 billion over the past 10 years—than any other U.S. industry except agriculture.

It will also mean the loss of jobs and tax revenues. Each $1 billion in exports creates 40,000 U.S. jobs. Last year, Boeing's export sales of commercial jet transports amounted to about $5 billion. About $3 billion involved Eximbank financing, which means that our Eximbank-supported sales created 120,000 jobs.

Impact on Suppliers

Among those affected by foreign sales are our direct suppliers and subcontractors. Boeing's supplier and subcontract network consists of 1,306 major and 2,247 small and minority business firms in 44 states. Their sales to Boeing were more than $6 billion in 1979.

If this seems like a large figure to you, remember that we subcontract about 53 percent of each 747. We are completely dependent on others to supply many of the 4½ million parts which go into this big jetliner.

In addition to our first-level suppliers, an estimated 50,000 second- and third tier firms provide parts and services to

our programs. These are the so-called "invisible" exporters, with skills, people, technology, and research capabilities that also depend on foreign markets. Any change in Eximbank policy that affects the major exporters like Boeing would also affect an extensive supplier network around the nation.

Jobs in the airplane segment of the aerospace industry have averaged about 500,000 annually for the past 10 years. The high-technology skills represented in this force are a critical national resource which would be readily available in case of a national emergency. Although commercial and military programs may have many differences, they are linked together and we ignore or compromise this linkage at our peril. Many of these same skills, facilities, and resources utilized in the commercial airplane sector would be required on a "surge" basis in case of a military confrontation.

We regard the reductions in Eximbank lending authority with considerable concern. If the planned cuts are implemented, we expect to suffer a significant loss in overseas sales, plus the follow-on loss of jobs and tax revenue to the government. We believe we can continue to obtain export orders when we do not directly compete with Airbus, but only if there is a more flexible approach to the use of Eximbank funding. The Bank must be in a position to provide guarantees that extend beyond the current 10-year term.

Although the longer-term loans available with the support of such guarantees will be more expensive, the level of debt service is easier to accept. It would be much like buying a home on a 10-year mortgage at 10 percent, or a 20-year mortgage at 12 percent. Most people will take the longer term, although at a higher cost. The availability of longer-term Eximbank guarantees may permit airlines to obtain fixed-rate money from insurance companies and pension funds.

Without the involvement of Eximbank, commercial banks will not participate in loans to emerging nations. This concerns me because many of the smaller, less-developed nations need air transportation to strengthen their economies. In many cases, air transport is the only way for these countries to bring their people together and stimulate some measure of economic progress.

In head-to-head competition with Airbus, it is especially important that we match the French for the initial order, because the first sale is the key to additional sales over a period of 15 to 20 years.

The High Cost of Losing

It is difficult to accurately predict the number of orders that will be lost or deferred if Eximbank financing participation is either not available or, if available, not competitive. However, our market projections indicate we will be competing for approximately $2.5 to $3.5 billion worth of orders in the balance of fiscal year 1981 and in fiscal year 1982 which we believe will require Eximbank participation. The loss of these orders in this time period could result in the loss of follow-on orders that over the next decade could approximate $10 billion. Of the $2.5 to $3.5 billion, approximately 55 percent involves potential 757 and 767 orders where we will compete head to head with Airbus Industrie. Approximately 45 percent will involve other sales campaigns, about one-half of which would be sales to airlines in emerging nations.

If we really intend to reduce dependence on Eximbank financing in competitive cases, we must have an enforceable international agreement. The Boeing Company would prefer to sell in the foreign market without benefit of subsidized financing, but it takes two to tango. For several years, the U.S. government has been negotiating in the Organization for Economic Cooperation and Development (OECD) to eliminate subsidized export financing. Boeing supports this objective but we believe that the only way we can convince the governments of the OECD to reach a meaningful agreement is to maintain a strong Export-Import Bank until such an agreement is reached. To do less than this puts U.S. exporters at a competitive disadvantage.

"I hope we're not loading up the gun to shoot the goose that lays the golden eggs. If things don't work out the way they're supposed to, years from now we'll probably have studies being conducted to find out what went wrong with the U.S. aerospace industry back in the 1980s."

It has been said that Boeing should have no problem with the cutbacks because it is a profitable corporation. I must confess that being chairman of a profitable company doesn't disturb me a bit —nor the company's stockholders, or its employees. It's another way of saying we're productive. Being productive—and profitable—does not mean that a private firm like Boeing can challenge the national treasuries of the Airbus consortium while at the same time committing to fund the multibillion-dollar, privately-financed investment needed to support its new airplane programs.

Levels of Investment

The negative cash flows required to support such investment levels are evidenced by the reduction in 1980 of $685 million in Boeing's cash and short-term investment position. With the 757 and 767 inventory pipelines filling up, we are projecting negative cash flows in both 1981 and 1982 to be in excess of $1 billion. I would emphasize, however, that these levels of investment are required even though the 757 and 767 programs are on schedule, meeting all performance targets, and within operating budgets.

I would also emphasize that a major portion of the company's earnings has been plowed back into the business. It is only through this reinvestment of earnings that Boeing has been able to substantially expand and modernize its facilities, to proceed with new jet transport programs such as the 757 and 767, and undertake model improvement programs on its existing jet transport family.

Over the past five years, dividends to stockholders have averaged 24 percent of earnings as compared to the median payment of the 30 Dow Jones industrial companies of 44 percent.

I hope we're not loading up the gun to shoot the goose that lays the golden eggs. If things don't work out the way they're supposed to, years from now we'll probably have studies being conducted to find out what went wrong with the U.S. aerospace industry back in the 1980s.

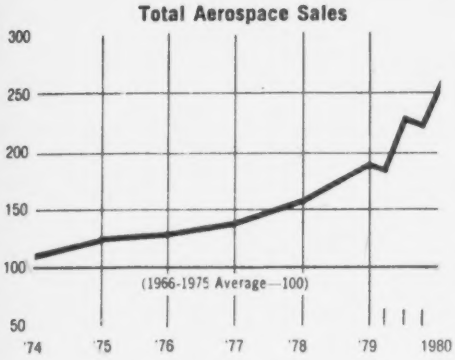
If we accept the current strategy —and its consequences—let us do so with an added proviso. We must monitor closely the cost versus the benefits resulting from the proposed stringent Eximbank program. We feel certain it will cost us overseas sales and defer the timing of exports. As export volume drops, it will affect jobs and the national trade balance —not just for one year but for 15 or 20 years in the case of commercial jet transports. It is essential that the administration acknowledge the costs imposed and that the Congress knowingly endorse these consequences. This cost-benefits analysis will provide a continuing examination of how theory stacks up against reality.

I must say that I do not believe the proposed reductions in the Export-Import Bank's budget authority will achieve the desired results. I think the ultimate costs will far outweigh the temporary benefits. The United States faces export problems of major dimensions. One of the few bright spots in the nation's foreign trade situation is the aerospace industry. I hope we're not the last of a dying breed.

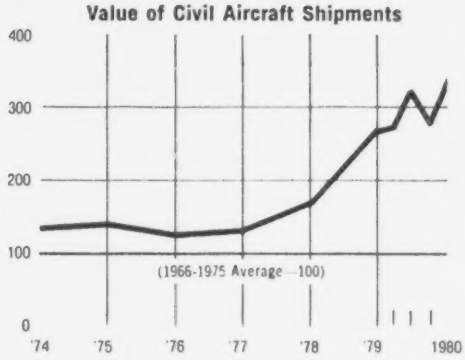
AEROSPACE ECONOMIC INDICATORS

CURRENT

Total Aerospace Sales



Value of Civil Aircraft Shipments



OUTLOOK

New Orders — Monthly Average

ITEM	UNIT	PERIOD	AVERAGE 1966-1975 *	SAME PERIOD YEAR AGO	PRECEDING PERIOD†	LATEST PERIOD 4th QTR. 1980
AEROSPACE SALES: TOTAL	Billion $	Annually	24.2r	46.1r	53.6	57.6
	Billion $	Quarterly	6.1r	12.4r	14.4	16.4
AEROSPACE SALES: TOTAL	***Billion $***	***Annually***	25.6r	27.5r	29.9	31.4
(In Constant Dollars, 1972=100)	***Billion $***	***Quarterly***	6.4r	7.4r	8.0	8.9
AEROSPACE PRIME CONTRACT AWARDS: TOTAL	Billion $	Quarterly	5.8	17.3r	16.8	18.6
U.S. Government	Billion $	Quarterly	4.1	9.1r	8.2	10.2
Other Customers	Billion $	Quarterly	1.7	8.2r	8.6	8.4
BACKLOG (Major Aerospace Mfgrs): TOTAL	Billion $	Quarterly	28.6	78.3r	92.2	95.1
U.S. Government	Billion $	Quarterly	15.9	36.1r	38.5	41.5
Other Customers	Billion $	Quarterly	12.7	42.2r	53.7	53.6
DEPARTMENT OF DEFENSE						
Aerospace Obligations: TOTAL	Million $	Quarterly	2,712	3,242	4,003	4,663
Aircraft Procurement	Million $	Quarterly	1,986	2,709	3,176	3,182
Missiles Procurement	Million $	Quarterly	726	533	827	1,481
Aerospace Outlays: TOTAL	Million $	Quarterly	2,405	3,415	3,265	4,007
Aircraft Procurement	Million $	Quarterly	1,741	2,816	2,661	3,241
Missiles Procurement	Million $	Quarterly	664	599	604	766
NASA RESEARCH AND DEVELOPMENT						
Obligations	Million $	Quarterly	780	1,104	1,090	1,261
Expenditures	Million $	Quarterly	789	874	941	1,118
EXPORTS						
Total (Including Military)	Million $	Quarterly	1,038	3,088	3,650	4,578
New Commercial Transports	Million $	Quarterly	345	1,271	1,561	2,096
EMPLOYMENT: TOTAL	Thousands	End of Quarter	1,166	1,162r	1,200	1,218
Aircraft	Thousands	End of Quarter	650	643r	660	669
Missiles & Space	Thousands	End of Quarter	114	106r	115	118
AVERAGE HOURLY EARNINGS, PRODUCTION WORKERS	Dollars	End of Quarter	4.38	8.82r	9.45	9.90
PROFITS						
Aerospace — Based on Sales	Percent	Quarterly	2.7	5.0r	4.3	3.9
All Manufacturing — Based on Sales	Percent	Quarterly	4.8	5.3	4.5	4.8

* Quarterly average computed as one-fourth of annual average.
† Preceding period refers to quarter preceding latest period shown.
r Revised.

Source: Aerospace Industries Association

AEROSPACE INDUSTRIES ASSOCIATION
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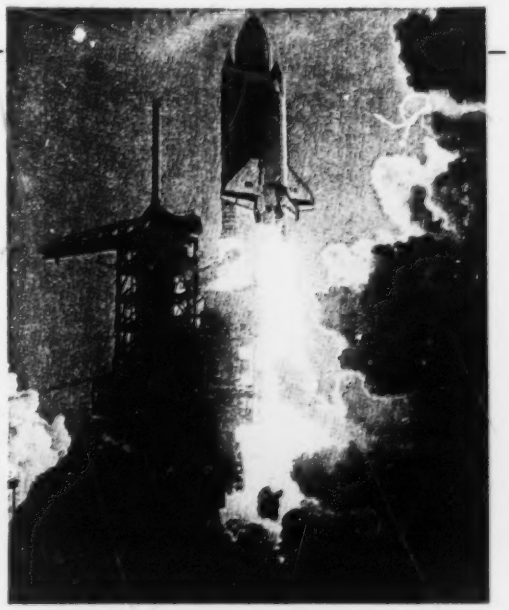

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